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CONTENTS.

Editorial 77
Ohio Electric Light Convention 80
Rapid Examination and Report Work 80
The Los Angeles Rate Situation 81
Decision Against Exclusive Telephone Service Contract 82
Municipal Lighting Competition in Pasadena 83
Extensions for Salt Lake City 83
Fence Wire as High-Tension Transmission Line 83
Schenectady Sectional Meeting of Empire State Gas & Electric Association 83
Convention of Canadian Electrical Association 84
Maryland Commission News 87
Wisconsin Commission News 87
New York Commission News 87
Massachusetts Commission News 88
Current News and Notes 89
A London Municipal Central Station 93
Colorado Hydroelectric Installation 97
Construction of 135,000-Volt Transmission Into Flint and Battle Creek, Mich. 98
A. I. E. E. Papers and Discussions 99
Electric Vehicle Promotion at Denver, Col 106
A "Prospect" Book for the Contractors 106
Repowering Machine Tools 107
A Silent Flatiron Campaign. By William H. Stuart 107
House Wiring at $2 Per Room 107
Residence Lighting 108
Home-Made Chandelier as Hooks and Loops. By E. B. Watson 108
LETTERS TO THE EDITOR:
Electrical Shows. By Geo. F. Parker 109
Illumination from Window Light. By Carl Hering 109
Digest of Current Electrical Literature 110
Book Reviews 114
New Apparatus and Appliances 115
Industrial and Commercial News 120
General News 124
Weekly Record of Electrical Patents 131

ELECTRICAL GOODS IN DEMAND.

We were able to comment optimistically on the figures of electrical export for April, but might be forgiven for being quite enthusiastic about those for May, which have just come to hand. The upward trend is not only maintained, but is marked very decisively; and we can only hope and believe that the process will continue until the line is crossed of the previous "highest record" of three or four years ago. This achievement begins to look like a possibility. The export of heavy electrical machinery for May, 1910, was $684,938 as compared with $479,951, a noteworthy gain in a department where even as late as April there had been retrocession. But in electrical instruments and apparatus the increase is most cheering. In May, 1910, the amount of value was $1,025,549 as compared with $539,424 in 1909, a gain of practically 100 per cent. When the two items are put together, May, 1910, shows a total of $1,710,487 as compared with $1,019,375, a gain of about $700,000. Nor is this all. The figures of the 11 months for the two items, put us back near the high line of 1907-8. The gross showing is as follows: 1908 a total for 11 months of $14,168,207; for 1909 a total of $11,261,894; and for 1910 a total of $13,253,600. The reversal to "good form" is so apparent we might almost be justified in expecting the full 12-month period to see the gap closed between 1908 and 1910 figures; but perhaps that is hoping for too much. It would certainly seem that 1911 would see the figures advanced to new high standards, and meantime we can take new courage from such a showing as the above.

One significant fact seems to emerge from all these data, namely, that the prosperity or magnitude of our electrical export trade depends now upon a greater variety being given to it. Thus the export of electrical instruments in 1910 for the 11 months was $7,791,539 as compared with $6,332,485 in 1908—a gain of nearly $1,500,000; whereas the export of heavy goods is nearly $2,500,000 below what it was in 1908. Here is an evident shift; and one wonders a little bit what it means. The great gain in miscellaneous goods is, however, full of encouragement; and while we have no means of checking off the nature of the goods, it can only be inferred that there is a growing heterogeneity of product in demand abroad. When we say "abroad," perhaps a little qualification is needed, as when British North America, Mexico and Brazil are taken out, what is left is not remarkably large, as they represent over $4,500,000 out of the $7,791,539 and are steadily increasing their purchases. Europe is hardly worth noting, and even a good customer like Japan seems to have little money to spend on American apparatus, just at the moment. Should large orders begin to come in from Africa, Australasia and the Far East our electrical export trade would go a-booming.

RATES BASED ON AREA LIGHTED.

Within the past two months considerable interest has been awakened in the question of changing systems of central-station rates so as to make the consumer, and especially the residence consumer, pay higher fixed or readiness-to-serve charges than

formerly, and at the same time reduce the kw-hour charge. Such, in effect, was the general trend of the paper by Mr. S. E. Doane before the National Electric Light Association, upon which we have already commented. Last month Mr. W. H. Winslow, of Superior, Wis., outlined before the Wisconsin convention a proposed system of rates for residence lighting designed to protect the central-station company from loss on this class of business when the use of the tungsten lamp becomes general. It appears that coincidently Mr. S. Bingham Hood, of Toronto, worked out what he calls the R. C. M. service-rate system which, in many respects, is similar to Mr. Winslow's, and which formed the subject of a paper, abstracted elsewhere, which was presented at the Canadian convention last week. The new departure in these systems is that the consumer is required to pay a certain fixed charge per month for a given amount of area lighted, the area being determined according to certain prescribed rules. Under these systems the consumer pays a comparatively high fixed rate per month and gets his electrical energy at a very low cost as compared to present practice. The systems devised by Mr. Winslow and Mr. Hood have taken certain important features from two well-known and extensively used systems of residence rates. One of these is the Doherty readiness-to-serve system, based on the Wright maximum demand system, which charges a fixed readiness-to-serve rate based on connected load. The other is the Detroit system, the distinguishing feature of which is that it virtually figures connected load as proportional to the number of occupied rooms in a house. Under the Detroit system a large discount from the basic rate is given after the consumer has used a given number of kw-hours, which number is dependent on the number of occupied rooms without regard to the connected load. By combining these two systems we have the systems proposed by Messrs. Winslow and Hood, which make a fixed rate based on the area or the number of rooms counted. The object of using area or number of rooms as a base rather than connected load is, of course, to avoid charging the consumer for a lot of connected lamps very infrequently used and which are put in as electrical conveniences and do not really increase the consumer's maximum demand. The results of experiments with the systems outlined will be watched with much interest.

REPORT OF GERMAN COMMITTEE ON UNITS AND SYMBOLS.

The annual report of the Ausschuss für Einheiten und Formelgrossen of the Verband Deutscher Elektrotecknikер has recently been published in the *Elektrotechnischer Zeitschrift*, and contains some particulars of international interest. There are two main propositions, namely, one on the value of thermo-mechanical equivalents, and the other on the units of conductance and conductivity. In regard to thermo-mechanical equivalents, the value of the gram-calorie at 15 deg. C. is recommended as 4.189 joules, or 427.2 kgm. This numerical value is likely to meet with very general recognition. It is pointed out, however, that certain recent researches have indicated the joule and watt to be short of their theoretical C.G.S. value by 0.03 per cent, or 1 part in 3300. This discrepancy, if it is confirmed, applies to the practical ampere-volt-ohm system as a whole, and is a physicist's question rather than an engineer's question. In the days of the B.A. ohm, this discrepancy was admitedly much greater. The second proposition is the substitution of the name Siemens for the mho, as the unit of conductance.

The electrical unit names thus far officially adopted at international electrical congresses are nine in all—ohm, ampere, volt, watt, joule, coulomb, henry, gauss and maxwell. Two of these are German, two French, three English, one Italian and one American. It is desirable that both Siemens and Kelvin should be added to this list, in recognition of the great services of both these eminent workers in electricity. It is, however, a pity to apply these names where they are not needed when there exists a demand that is likely to increase for names of other electrical units now nameless. The Germans desire to use Siemens for what is already generally known as the mho, and to replace by an effort of memory what takes no effort at present. The British also desire to use Kelvin for what is already generally known as the kw-hour, and to replace something that does not require to be learned—something self-understood—by something to be learned with an effort. This may be magnificent, but it is not war, in applied science. On the other hand, we need names for units of electrostatic flux, flux-density, and other quantities in electrostatics that at present are neglected for want of christening. These quantities will probably insist upon being recognized and talked about in the future when new burdens on memory must be imposed.

A valuable contribution on symbology is appended by the committee in which a systematic development of decimal multiples and sub-multiples is propounded. In particular we applaud the openly expressed proposition that, as far as possible, symbols for units should be chosen with a view to subsequent international adoption. This contribution to symbology is worthy of careful study by electrical engineers in all countries. A useful distinction is offered between the symbol for a gram, or any of its multiples, as a unit mass, and as a unit gravitational force, by appending an asterisk in the latter significance. As a minor criticism it may be pointed out that two atmospheres are defined, namely, the technical atmosphere of 1 kg* per square centimeter and the so-called physical atmosphere of 76 cm mercury at 0 deg. C. We think the latter should be referred to as the standard barometric atmosphere. The standard physical atmosphere should be 1 megadyne per square centimeter, as already used internationally in many physical books and pamphlets, and as recommended by the International Bureau of Weights and Measures.

PORTABLE STANDARD OF LIGHT.

Despite all the work that has been done on primary and secondary standards of light, it is an unfortunate fact that nothing of the sort really suitable for a working standard for photometry in the field has yet been devised. Incandescent lamps are beautifully adapted to permanent work in the laboratory, yet when it comes to street photometry, which is daily assuming greater and greater commercial importance, they are exceedingly inconvenient. Most of the weight, which is considerable, of every portable photometer, is in the reference lamp and its equipment, battery, measuring instrument, rheostat and so forth. Yet so far these things are indispensable, since without a well-controlled standard lamp precision is quite out of the question. Indeed, without this, one is almost driven to photometers of the reading or extinction type, so uncertain and subject to personal equation that their use would be a practical joke were it less frequently employed to deceive. No matter whether an incandescent lamp is used by regulating the voltage, the current or the watts, it still requires too much attention, if

reasonable precision be desired, by reason of the very great variation of light with any one of these quantities—a variation of the order of 5 per cent at the lamp and 1 per cent at the instrument. If there were only such a thing as a battery of sensibly constant voltage and moderate weight, one would take some chances with small variations, for in street work the highest precision is not required; but unless one carried about a storage battery of most inconvenient weight and handled it as gently as a case of eggs, the chance of getting down to a constancy of 1 per cent or so is small. In the original Weber photometer-progenitor of most of the portable type, a benzine lamp was employed, and it may be an open question yet whether, when carefully used, it was not nearly as reliable as the later members of its tribe.

We are by no means disposed to deny that very good photometric work can be and is being done in the field with portable instruments using incandescent standards, but it is at the cost of a very considerable amount of trouble and time. A relatively simple instrument conveniently worked by a single man is greatly to be desired, even if it should lack the highest degree of precision. In testing street lamps, for example, it is highly desirable to work through a considerable territory in an evening without attracting the attention of a large and inquisitive crowd by the profuse display of instruments. The present tendency toward depending much upon field measurements in electric lighting contracts gives this matter large importance. We have more than once showed the practical futility of such determinations as a measure of price, but they are of value in showing whether a contract is or is not being in general lived up to. A reference lamp trustworthy for an evening's work within 2 or 3 per cent, or even 4 or 5 per cent, would be a boon to all who undertake field photometry. It need not even be constant within these limits if its variations are fairly regular and determinable. The choice seems to lie between using a battery giving nearly constant voltage or small decrement, and some form of flame illuminant possessing similar qualities of steadiness. Automatic voltage regulators may be left out of the question as involving such an increase of weight and complication as is sought to be avoided. Incandescent lamp schemes are handicapped by the extreme probability that the shaking up of the battery during transportation will cause irregular variations of voltage, and against the lamps is to be charged the trouble due to draughts and to temperature variations. It is, of course, easy to meet the requirements if weight, bulk and number of operators be left out of consideration, but this is not the thing at issue. It is not precision to ½ per cent, with a half-hundred weight of apparatus and three or four operators that is needed, so much as quick readings to 4 or 5 per cent with an equipment that one man can carry and use. And within these limitations the apparatus should be a measuring device and not a mere adjunct to guessing not always disinterested.

DISRUPTIVE STRENGTH WITH TRANSIENT VOLTAGES.

Several valuable papers on subjects related to dielectric strength were read at the recent Jefferson convention of the American Institute of Electrical Engineers. Dielectric strength is becoming of increasing concern to the electrical engineer, in view of the steadily rising tensions employed in energy transmission. It is necessary to employ ample dielectric strength in order that the electric stresses may be safely sustained, while, on the other hand, an excessive amount of dielectric strength is necessarily very expensive. In the study of dielectric strengths great complexity is revealed. Take, for example, the atmospheric air, the most commonly used dielectric. The strength of air depends upon the distribution of the electric stress, the duration of its application, the chemical state of the air, its temperature and hydrostatic pressure. At very high pressures, or many atmospheres, the dielectric strength is relatively high, and at very low pressures it is relatively low, until a certain critical low pressure, or approach to vacuum, is reached, below which the dielectric strength rises again rapidly.

Very little is yet known concerning the effect of time application in electric stress upon dielectric strengths. It has been recognized that a certain small amount of time is necessary to attain the full sparking distance corresponding to a given tension. A paper on this subject was presented by Messrs. J. L. R. Hayden and C. P. Steinmetz. The method they employed consisted in applying a direct-current pressure to the primary terminals of a step-up transformer, through an adjustable non-inductive resistance, and computing, from the constants of the primary circuit, the amount and the equivalent time application of the corresponding wave of high tension in the secondary circuit. It appears from the experimental results given in the paper that when the time of applying the tension to opposed needlepoints in air is a fraction of a millisecond, the striking distance may be only a small percentage of the full striking distance for that tension when sustained. The lowest percentage of full striking distance was 3.3 per cent, for the case of 105 kilovolts with 0.14 millisecond. This percentage, increased to 97 per cent, at the other extreme, with 15 kilovolts and 15.8 milliseconds. It is manifestly difficult to define the precise electric conditions at the needlepoints when the impulse only lasts a fraction of a millisecond. The whole mass of surrounding air is yielding electrically, in condenser fashion, and the voltage actually developed during this time may be markedly less than that generated within the transformer, owing to this elastic displacement. A very evident result of the research was that air disrupts much more speedily than oil.

The existing theory concerning the rupture of a gas under electric stress is that at or above a certain critical electric intensity, in volts per centimeter, the gas molecules become electrically decomposed into positive and negative constituents; or becomes ionized. The ions, or electrified particles, are then, like ordinary electrified pith balls, subject to attractive and repulsive forces, in obedience to which they generate velocities considerably in excess of those corresponding to air molecules at the environing temperature, according to the kinetic gas theory. The ionic projectiles, flying like cannon balls, impact upon neighboring undecomposed molecules, and smash them into decomposition. Consequently, ionization spreads rapidly, by contagion, through the mass of air, once the critical disruptive intensity has been reached. A certain time must be allowed, however, for these kinetic actions to be effected, so that a very brief electric intensity can be withstood by air without rupture, far in excess of what would be sufficient to disrupt it if continued for a single second of time. Moreover, the larger and slower the molecules, as in a liquid like oil, the longer the process of ionization, and we may readily conceive of a gaseous dielectric disrupting more quickly than a liquid dielectric.

Ohio Electric Light Convention.

The following program has been prepared for the sixteenth annual convention of the Ohio Electric Light Association, to be held at Hotel Breakers, Cedar Point, July 26 to 28. Every effort will be made to bring forth discussion of the papers presented.

"Low-Pressure Turbines and Their Operation," by Mr. W. C. Anderson, Canton; "Turbine Troubles," by Mr. Frank Brosius, Columbus; "Motors for Single-Phase Circuits," by Prof. F. C. Caldwell, Columbus; "Introduction of Electric Vehicles in Ohio," by Mr. J. T. Kermode, Cleveland; "Getting New Business in Cities of 15,000 or Less," by Mr. L. A. Petit, Jr., Middletown; "Experience with Tungsten Lamps for Street Lighting," by Messrs. Claude Smith, C. C. Custer and Frank Jackley; "Tungsten Lamps vs. Central-Station Earnings," by Mr. E. L. Booth; "Central-Station Facts and Factors," by Mr. J. R. Cravath, Chicago; "Methods of Maintaining Electric Meter Accuracy," by Mr. John Gilmartin, Toledo; "Methods to Be Followed in Purchasing Station Apparatus," by Mr. R. J. Feathers.

There will be entertainments as follows: Musicale on Tuesday afternoon for the ladies and the association dinner in the evening. Launch ride for the ladies on Wednesday, banquet and ball in the evening. Musicale for the ladies on Thursday afternoon, and association theater party in the evening.

Rapid Examination-and-Report Work.

In no department of effort connected with the electric service industry has there been more marked advancement during the last few years than in the work of making engineering examinations and reports of properties where the aid of financiers is sought to make extensions, or where the property is offered for sale or a consolidation is proposed. A recent instance of work of this kind, involving a $40,000,000 deal, in which an Eastern syndicate was interested, constitutes a record, possibly, for this class of work, and is of much interest. The syndicate in question obtained a 30-day option on the property involved, and H. M. Byllesby & Company, of Chicago, were instructed to examine the entire plant and make a comprehensive report. These properties consist of no less than 28 street-railway, gas and electric light companies and a holding company, there being 29 distinct organizations in all.

The option expired on June 25 and owing to some delays in getting the work started, it was June 1 before two experts and a stenographer from the engineer firm left Chicago for the scene of operations. On June 3 Mr. Harold Almert, the head of the Byllesby & Company's department of examinations and reports, followed. An assistant stenographer was employed at the scene of operations, and the elaborate report which was compiled was the work of these three engineers and two stenographers. The Chicago members of the party came back with the report completed and bound on June 21. This report consists of 286 typewritten pages of the ordinary letter-paper size, accompanied by 28 photographs and four maps and diagrams. It was completed four days before the expiration of the option, giving the bankers who were interested in the proposed deal time to reach their decision. To make such a very thorough report as was made on these 29 distinct companies in the space of 21 days was an achievement worthy of note.

The report was most thoroughly and carefully made. It included, first, an examination of the books of each of the 29 companies. The examiners drew off a statement of earnings, showing receipts and disbursements for each year from 1906, including the first five months of 1910. A trial balance was then struck for each company showing the assets and liabilities. In addition an analysis of the profit-and-loss account of each company was made, going back to the time that each company was taken over by the holding company. Furthermore, there was a very complete analysis of the construction account of each company, reviewing all the vouchers to determine whether they had been distributed to the proper account and to show whether any of the items should be charged to operation or maintenance rather than to construction. It may be mentioned that a number of such items were found.

With this information the examiners then made up a sheet of statistics for each company, giving a comparative statement of operation, and going into details of cost of generation and distribution, general expense, etc. These figures were given very carefully for each department of the business, as street railway, electric light and gas. In the electric light department, for instance, the figures showed, for each company, the total kw-hours delivered at the switchboard, the average cost per kilowatt generated, details of cost of generation, details of cost of distribution, and an analysis of the general expense, all reduced to a kw-hour basis. Similar figures were given in the case of each company for the gas and street railway departments. Then the figures for all the companies were summarized, and a similar sheet was made out for the entire system.

The next step in the report was the making of replacement values for each company separately, and also a summary for the whole system. Then estimates for depreciation were made for each property in detail and summarized for the whole system by departments. In figuring depreciation renewals were relied upon to keep the various properties to a 100 per cent value. However, no matter how faithfully the parts of a piece of apparatus or a system are renewed as they wear out, there will come a time ultimately when the whole will be used up or so antiquated as to have survived its usefulness. Therefore, with the most careful system of renewals there must still be a further allowance for depreciation, and in the case of the system under examination this final figure for depreciation was figured out to amount to 2.58 per cent. This, it should be explained, was after all ordinary replacements chargeable to operation had been made, and, in addition, after an allowance of 3.42 per cent had been made for maintenance. These figures were arrived at by going into all the constituent parts of each property and fixing the life of each by itself.

After determining what the physical property of the system was worth, the examiners made a survey of the territory served, going back 20 years, studying statistics of population, the growth of the territory, etc. Next, a forecast of the probable growth of population for the next five years was made. This was done to estimate the requirements necessary to serve the territory in 1915 and in intervening years, presupposing proper, up-to-date management. In doing this the examiners made a complete forecast of the financial requirements of the system for each year, estimating the gross income, the operating expenses and the net income. Then, the next step was the estimating of what proportion of the increased capital requirements would be needed each year, and what the equivalent would be in bonds at the probable price at which the bonds could be marketed. This, in turn, gave the increased amount of bond interest to be met. With these figures available a new valuation of the property was figured, and then the depreciation was calculated on this new valuation. This enabled the experts to arrive at a total of the interest and sinking fund required for each year in the future period under consideration —that is, up to and including 1915. Deducting this total from the net income gave a statement showing what the probable surplus or loss would be for each year of the future period. These, of course, were very important figures to the prospective investors.

Furthermore, the experts made a careful study of the scope of the business, the nature of the territory served, the character of population, and the class of industries; also actual or possible competition, as from steam railroads in the railway end of the business, and the like. It also was considered whether the territory was largely dependent on one industry, so that it would be unduly affected in case of a period of business depression. A study of the postal receipts also was made to indicate the character of the territory served. Then a careful

examination was made of the franchises of the various companies to determine exactly their life and whether they contained any burdensome restrictions; also how they would fit into a possible reorganization. From studies of this character final conclusions were drawn as to the general management of the properties and their future prospects.

The report included a drawing of every piece of real estate owned by any of the companies. At the bottom of the page containing each drawing of this character was a photograph of any building or portion of plant equipment on the particular piece of real estate shown by the drawing above.

The whole task of preparing this large and elaborate report in such a short time was executed something after the manner of a rush newspaper job. All the necessary equipment was moved on the ground from the Chicago office, and while the experts were preparing one sheet of copy the stenographers were typewriting and making five copies of the previous sheet. Every night the stenographers caught up with the work of the experts for that day. The last task undertaken by the makers of the report was the drawing of conclusions from the mass of material previously prepared. Then the sheets of the report were ready for assembling, and a table of contents was made. Finally the 286 typewritten pages were bound in leather covers with photographs, maps and drawings and the report was complete.

The Los Angeles Rate Situation.

Following the action of the city administration of Los Angeles in adopting an ordinance decreasing the basic rate for electricity from 9 cents a kw-hour to 7 cents, the question was voted on at a special election held in that city on June 30. Between the date of the Council's action and the election there was an exciting campaign in which the proposed reduction was discussed from many angles. The companies strenuously opposed the change, asserting that they could not make a fair return to their stockholders at the proposed price. However, the Southern California Edison Company announced by circular that if the "7-cent ordinance" was defeated an 8-cent basic rate for electric service, with a monthly minimum of 75 cents instead of $1, would be put into effect; furthermore, that contemplated additions and extensions would be made as originally planned. When the ordinance was first passed the company announced that all extensions and improvements would necessarily be abandoned if the reduced rate was made mandatory.

At the election of June 30 the vote stood 18,488 for the 7-cent ordinance and 8961 against it. The electric-service companies were naturally disappointed, although they hardly expected, of course, that the users of electricity would vote money out of their own pockets by rejecting the ordinance. They had hoped, however, that perhaps the majority of citizens might be influenced by their arguments and accept the 8-cent compromise.

It is altogether probable that litigation will follow before the companies submit to the new rate. The Southern California Edison Company, by Mr. R. H. Ballard, its secretary, made this announcement after the election:

"We are agreeably surprised by the very large vote cast against the unfair lighting rate ordinance, and we firmly believe that had we been allowed a reasonable time to continue the campaign of education and publicity, which was only started a short time ago, the ordinance would have been defeated.

"As the rates provided by the ordinance will not afford a reasonable return on the capital actually invested, we are forced to take such steps to protect ourselves as may be properly taken under the law.

"We greatly appreciate the splendid assistance rendered us by our employees and friends, and a portion of the press, and regret that their efforts were unsuccessful."

Mr. A. C. Balch, general manager of the Pacific Light & Power Company, is credited with the statement that his company will take the matter into the courts in an endeavor to protect what the company considers its stockholders' rights. Very likely similar action will be taken by the Los Angeles Gas & Electric Company.

Much of the electricity used in southern California is obtained by the development of water-power, and the position of the Los Angeles authorities seems to be that the companies are charging too high a price to the small consumers. The city officials appear to be very much exercised because the electric-service companies sell electrical energy to railway corporations for ¾ cent per kw-hour and are skeptical when the companies say they can make more selling at wholesale to the railway companies at ¾ cent than by delivering the current to small, short-hour consumers at 9 cents. The companies contend that they did not have sufficient time to make a campaign of education for the purpose of making this point clear to the lay mind.

Some of the newspapers are active in favoring a municipal electric plant for Los Angeles.

An interesting feature of the Los Angeles campaign was a dinner tendered to the officers of the Southern California Edison Company a few days before the election by about 300 employees of the company. The sentiments that animated the occasion may be judged by the following list of the toasts of the evening: "A Soulless Corporation," by Mr. S. M. Kennedy; "One Good Turn Deserves Another," by Mr. W. E. Boden; "A Happy Family," by Mr. S. Darnell; "A Square Deal," by Mr. J. H. Peiper; "Squad Ready," by Mr. C. S. Walton; "Publican and Pharisee," by Mr. P. Ducker; "How I Am Going to Vote and Why," by Mr. W. A. Raymaker; "From the Ground Up," by Mr. W. L. Frost; "Liberty," by Mr. H. D. Thaxter; "Between the Devil and the Deep, Deep Sea," by Mr. R. H. Ballard; "Lest We Forget," by Mr. Frank Balfour; "Play Ball," by Mr. Charley Sherrart; "The First Law of Nature," by Mr. E. H. Mulligan.

The following communication on the Los Angeles situation, dated July 2, has been received from Mr. Le Roy Allison, of that city:

"While to a great degree of local interest, the question of lighting rates, which has engaged the attention of Los Angeles lately, is one which may arise in any city. The determination on the part of the average consumer is to obtain current at the lowest rate possible, whether it be consistent with the territory in which he resides or otherwise; for the former, embodied in its single sense, he cannot be reproved—this is human nature; but, coupled with the latter, the citizen should contemplate the effect of what borders on the confiscation of property. To take away a fair rate of income on an investment in a public commodity may insure the saving of a few cents to the small consumer, but entails the transaction of business by a service company at a profit so trifling as to forbid seeking for new business where expenditure for construction is necessary.

"The rates for electric service, both for lighting and power, are always subjects for controversy. Even though a rate is just, not only from the utility company's point of view, but from the discreet consumer's conclusions drawn from his own premises, the critical resident is always in evidence. Basic rates for service founded upon the investment, depreciation and cost of maintenance have been established. In some cases they are under the control of State Commissions and in others are regulated by municipal authority; a perusal of the appended table will prove an assertion that in the majority of cases they are illustrative of equitable treatment and are not delusions of visionary minds or corrupt power.

"A Public Utilities Commission at Los Angeles recommended to the City Council a reduction in service rates of 2 cents per kw-hour; acting upon such suggestion this latter body drafted an ordinance on May 28 enforcing a rate of 7 cents in place of the former 9-cent rate, with a minimum of $1 as heretofore. This made a direct cut of 22 per cent. The investigation of the Board of Public Utilities was expedited to an extent that left no doubt as to its inaccuracy. The appraisal of the capital invested, the details and expense of operation were passed over lightly. Its recommendation was based on a comparison with the rates for supplying railways at ¾ cent, and the current rate at Pasadena, namely, 4 cents per kw-hour. The

latter is the price at which the Edison Company is forced to sell that city in competition with a municipal plant, to derive such revenue from its property as it can; it is in no wise a business proposition; it is a question of salvage. Furnishing railways 10,000 times as much energy at ¾ cent at the switchboard is far more profitable than supplying the average residence consumer a few hours at 9 cents, where the investment in distributing systems and meters, the cost of care and maintenance, billing and collecting is vast.

"Where it may be claimed that public-utility companies rule a city, it is also true that they assist greatly in building one and adding to its prosperity. The peculiar conditions surrounding the growth of a Western city, such as Los Angeles, where new tracts of land are being continually improved and opened to public sale, make it imperative, in this enlightened period, that public commodities—railroads, gas, electricity—be in the vicinity. In extensions of this character the lighting companies have invested millions of money obtained from the Eastern market upon their securities. If proper returns are not forthcoming to the Eastern investor and his capital is placed in jeopardy, he will seek other fields.

"This is the situation in Los Angeles, and the case was submitted to public vote on June 30, with the populace in favor of the low rate, as was to be expected; the leading industrial institutions, however, voted for a compromise of 8 cents per kw-hour, which was offered by the companies affected in their efforts to continue extensions and services, which interpretate prosperity to the city.

"The three companies interested are the Southern California Edison Company, the Pacific Light & Power Company and the Los Angeles Gas & Electric Company. With their offer for compromise rejected they turn to the only alternative—the courts—where the just rate will be argued along technical lines. Meantime, further extensions of systems come to a standstill; solicitors, linemen, clerks are taken from the payroll, realty interests are jeopardized and prosperity, which is dependent, will be stunted.

LIGHTING RATES EFFECTIVE IN 58 AMERICAN CITIES.

	Population	Basic Rate
Atlanta, Ga.	150,000	.09c W.P.
Albuquerque, N. M.	10,000	13.5
Baltimore, Md.	650,000	10 C.F.
Birmingham, Ala.	60,000	10.4
Boise City, Idaho	20,000	15
Boston, Mass.	630,000	11
Brooklyn, N. Y.	1,600,000	12
Buffalo, N. Y.	415,000	.09* W.P.
Burlington, Vt.	22,000	10
Butte, Mont.	65,000	11.8 W.P.
Chicago, Ill.	2,600,000	12 C.F.
Cheyenne, Wyo.	20,000	12
Cincinnati, Ohio	460,000	10*
Cleveland, Ohio	550,000	12.5
Denver, Col.	230,000	8 W.P., C.F.
Des Moines, Iowa	100,000	12*
Detroit, Mich.	450,000	12.6
Fargo, N. D.	15,000	10
Grand Rapids, Mich.	110,000	8** W.P.
Guthrie, Okla.	23,000	15
Hartford, Conn.	100,000	11*
Houston, Tex.	100,000	13*
Indianapolis, Ind.	250,000	10 C.F.
Kansas City, Mo.	375,000	10 C.F.
Little Rock, Ark.	60,000	13.5
Los Angeles, Cal.	350,000	.07 C.F.
Louisville, Ky.	290,000	8.4
Madison, Wis.	26,000	14.5
Manchester, N. H.	70,000	12*
Memphis, Tenn.	200,000	10
Milwaukee, Wis.	375,000	12*
Minneapolis, Minn.	310,000	10 W.P.
Natchez, Miss.	18,000	13.5
Newark, N. J.	350,000	10
New Orleans, La.	375,000	17.1
New York, N. Y.	3,000,000	10
Oakland, Cal.	200,000	9 W.P.
Omaha, Neb.	150,000	14*
Philadelphia, Pa.	1,500,000	13.5 C.F.
Pittsburg, Pa.	600,000	10 C.F.
Portland, Me.	65,000	9
Portland, Ore.	275,000	15* W.P.
Providence, R. I.	215,000	12
Raleigh, N. C.	18,000	13.5
Richmond, Va.	116,000	10 W.P.
Rochester, N. Y.	200,000	8* W.P.
St. Louis, Mo.	750,000	12
St. Paul, Minn.	235,000	13.5
Sacramento, Cal.	55,000	.09 W.P.
San Antonio, Tex.	125,000	14.5
San Francisco, Cal.	500,000	.09 W.P.
Salt Lake, Utah.	100,000	10 W.P.
Spokane, Wash.	85,000	10 W.P., C.F.
Seattle, Wash.	200,000	.09** W.P.
Sioux Falls, S. D.	15,000	18
Topeka, Kan.	50,000	.09 C.F.
Washington, D. C.	350,000	10**
Wheeling, W. Va.	50,000	13.5 C.F.

W.P., Water Power; C F., Cheap Fuel; *, 5% discount allowed for cash; **, 10% added to bills where not paid promptly.
The average rate for above (omitting Los Angeles) is 11.4c per kw. hr.

Decision Against Exclusive Telephone Service Contract.

The New York State Court of Appeals in an opinion handed down June 14, and reported in the *New York Law Journal* of June 25, considers the case of a contract for a term of nine years between a telephone company and the proprietor of a hotel, under which the former installed at a considerable expense a private exchange in the hotel subject to the provision that the lines of no other company should be permitted in the house or connections made therewith. The hotel in question is the Yates Hotel, of Syracuse, and the telephone installation was made by the Central New York Telephone & Telegraph Company, at an expense of $2,700. The court held that such a contract, although only in partial restraint of trade, involved to that extent an injury to the public interests and is therefore void. On the other hand, the contract being divisible with respect to its valid and invalid parts, the company may lawfully insist that its system be retained in the hotel, without preventing other telephone systems being introduced therein.

The court held that the public franchises which telephone corporations enjoy are granted to promote the transmission of vocal messages between the largest numbers of persons who can be brought into communication with one another under satisfactory economic conditions. This purpose is frustrated by any agreement which operates to prevent the rendition of telephone service where otherwise it could be obtained. A contract between a telephone corporation and one of its subscribers whereby the latter excludes all other telephone service from his premises deprives all the patrons of that other telephone service from telephonic communication with such subscriber and all the occupants of his premises. Though the number affected by one such exclusive contract may not be large, if exclusion may be exacted from one customer it may be exacted from all, and so a corporation first in the field might establish a monopoly to the detriment of a large proportion of the community and their deprivation of telephonic intercommunication.

The court also held that the invalid part of the contract could be separated from the valid part, and, therefore, while the plaintiff was not entitled to enjoin the defendant from introducing into the Yates Hotel other telephone systems than those which the plaintiff had furnished under his contract; on the other hand, inasmuch as the defendants admitted that they proposed to discontinue and abandon the use of the private hotel exchange with which the plaintiff had equipped the Yates Hotel, the plaintiff was entitled to prevent such discontinuance and abandonment. In other words, the plaintiff was entitled to a part of the relief which it claimed, but not all. It could lawfully insist that the defendants should retain and continue to employ its telephone exchange and telephone system, but it could not lawfully prevent the defendants from admitting other telephone systems or placing other telephone exchanges in their premises. Under these circumstances the only remaining inquiry is what relief can be afforded upon the present appeal to the defendants, who are under a legal obligation to comply with every portion of their contract with the plaintiff except that portion which relates to the exclusion of other telephones.

Municipal Lighting Competition in Pasadena.

Pasadena, Cal., has a municipal electric lighting plant, and an active controversy is in progress between the city authorities and the Southern California Edison Company in relation to electric service and lighting rates. The rate has been cut in Pasadena to 5 cents per kw-hour, and the competition between the central-station company and the municipality appears to be keen. At a recent mass meeting in that city the Pasadena Municipal Lighting League was organized to assure the permanency and success of the municipal plant. It is said that this organization is the only one of its kind in existence. This body declares that the municipal plant has been the direct means of securing to the people of Pasadena fair service at reasonable rates and affirms that the permanency of the municipal plant is a matter of the greatest importance, not only to the people financially as individual users of electricity, but also as a matter of civic progress and integrity.

There has been considerable discussion of the possibility of the Edison Company selling electricity to the municipal plant in Pasadena at wholesale rates. Mayor Earley of that city says that before the last $150,000 of bonds was voted to enlarge the municipal plant he endeavored to secure electricity from the Edison Company at wholesale rates. The company would not sell, however, unless the municipal authorities would agree not to go into the commercial lighting business, and this stipulation was refused. Mr. C. W. Koiner, manager of the Pasadena municipal plant, was recently reported as declaring that the city is connecting up from 15 to 20 new consumers daily. He is thus quoted: "If there is any advance at all on the part of the Edison Company to sell the city wholesale electrical energy, it will no doubt be received candidly by the city, and if it is possible profitably to enter into such an agreement with the Edison Company the city will undoubtedly do so. The matter will be considered on a purely business basis, however." On July 1 the municipal plant reported over 3000 customers, while the number aimed at by Sept. 1 is 4000.

Fence Wire as High-Tension Transmission Line.

A curious combination of circumstances proved that even a lowly barbed-wire fence may serve efficiently as a 25,000-volt transmission line, in the experience of a Michigan hydroelectric company some time ago. The men in charge of a substation from which the street railway and lighting of several considerable towns beyond receive energy, had been given no intimation that the 25,000-volt, three-phase line between them and the generating station was in trouble until some farmers working in a field several miles away telephoned in and reported that one of their number had received a severe shock from a barbed-wire fence on his place, near the high-tension line. The attendants were incredulous that this fence could become charged without some indication at the station, as they reasoned that had a line wire broken and fallen on the fence service would certainly have been interrupted. Word of the trouble came in just before noon, and a gang was dispatched to investigate the cause of the electrified fence.

Coming near the charged section they found that the 110-ft. span of one of the lower wires of the 25,000-volt, three-phase circuit had broken at a point about one-third the distance from one pole and had fallen so that it hung against the top wire of the fence. The other end of the span had also fallen across the fence further along, its loose end lying in the grass. The result, of course, was a through circuit completed by the fence wire.

The transmission line at this time was carrying about 100 amp per phase, at 25,000 volts, but the loose contacts gave no evidence of distress except for a few faint sparks from time to time. As the transmission was needed for delivering the full load of two towns whose service it was not desirable to interrupt, and as the fence wire which acted as part of the high-tension circuit was fortunately dead-ended at two posts about ¼ mile apart, it was decided to patrol this section and warn persons away until midnight, when the circuit could be cut out and the break repaired. This was accordingly done, and the barbed-wire fence carried its share of the evening peak without any indication of the unusual jumper's existence ever coming to the consumer's attention. From the leakage down the posts while in this condition all of the wires of the fence became dangerously charged for the quarter-mile distance, as an inquisitive neighbor's dog discovered while investigating the unusual excitement on his master's "east forty."

Extensions for Salt Lake City.

Work has been begun on a large steam reserve power plant for the Utah Light & Railway Company, of Salt Lake City. The station, which, with its equipment, will cost possibly $600,000, will be placed on the Jordan River near the present steam plant and transformer station of the company. This plant is under construction for the purpose of insuring a continuous supply of electricity for lighting and motor service and for street-railway operation in Salt Lake City and Ogden. The company has sufficient generating capacity in its water-power plants to handle its regular demands for electrical energy, and the new steam plant will be held in reserve to carry a portion of the load at times of unusual peak or to be used in case of an emergency.

The first unit of this reserve steam plant will consist of a turbo-generator capable of delivering continuously 13,500 electrical horse-power. This unit is said to be the largest piece of electrical generating apparatus between the Mississippi River and the Pacific Coast. Six boiler units of sufficient capacity to provide the necessary steam for this generator will be installed in a boiler-room separated from the turbine-room of the station by a fire wall. Elaborate coal and ash-handling equipment is provided, as is also a full condensing equipment.

The contract for the construction of the plant has been let to Westinghouse, Church, Kerr & Company, of New York. The resident engineer for the contractor is Mr. H. A. Brinkerhoff, while Mr. O. A. Honnold, electrical engineer of the Utah Light & Railway Company, will supervise the erection of the plant for his company.

Schenectady Sectional Meeting of Empire State Gas and Electric Association.

The third of the sectional meetings of the Empire State Gas and Electric Association for the present year was held in Schenectady on Friday, July 8. Through the courtesy of Mr. M. W. Offutt, general manager of the Mohawk Gas Company and the Schenectady Illuminating Company, and of some of the officers of the General Electric Company, the meeting was held at the Mohawk Golf Club. The session started at 10 o'clock and adjourned at 1 o'clock. The delegates, about 60 in number, were then entertained at luncheon in the Golf Club, following which they visited the works of the General Electric Company and the gas plant of the Mohawk Gas Company.

At the session in the morning, Mr. C. D. Haskins, of the General Electric Company, presented a short paper on the use of electricity in gas works, which provoked some little discussion, as there seemed to be a slight difference of opinion in regard to the advantages and disadvantages. Among other things it was pointed out that extreme care should be used in the wiring in case electric motors or electric lamps were used in gas works. The question of 25-cycle lighting was next taken up, and Mr. E. W. Allen, of the General Electric Company, discussed the subject informally, after which numerous questions were asked him and the discussion became general.

In preparation for the meeting, the members had been asked to suggest subjects which could be taken up informally, but it was found impossible to take up many of the questions suggested. There were four matters in regard to the use of electric fans and the discussion on this subject was quite general. It was pointed out that there were so many wrinkles in the

use of electric fans that it would be advisable if somebody would prepare a pamphlet which could be distributed to the users of fans which would suggest to them not only the proper method of use for ventilation, but also many other ways in which the fans could be employed during other seasons of the year.

Canadian Electrical Association Convention.

One of the most notable gatherings in the history of the Canadian Electrical Association was the twentieth annual convention held at the Royal Muskoka Hotel, Muskoka Lakes, Ontario, from July 6 to 8. Delegates to the number of about 200 gathered, not only from Canadian points, but from the United States also. There were present representatives from the two important American sister societies, the National Electric Light Association and the American Institute of Electrical Engineers. From the first-mentioned came President W. W. Freeman and Secretary T. C. Martin; representing the latter was ex-President Chas. F. Scott. After an absence of several years Mr. Frederic Nicholls, of Toronto, an ex-president of the National Electric Light Association, was present and took an active interest and part in the proceedings, while Mr. Leonard Andrews, of London, England, was also in attendance. A consideration of the question of affiliation with the National Electric Light Association was an important feature of the convention, and while no definite action was taken towards bringing this matter to a climax, it is not unlikely that it will claim a share of the attention of the Canadian Association's members at an early date.

The business sessions during the meeting were well attended, and while this was, perhaps, to a great extent due to the absence of many of the distractions which usually claim the delegate's attention in urban centers, yet to the papers read this must be attributed in no small measure. The papers were exceptionally well prepared and reflected great credit on the authors and also upon the papers committee, composed of Messrs. A. L. Mudge and R. G. Black, of Toronto.

The social and entertainment features of the convention were most enjoyable. Situated 100 ft. above the sea-level, the "Royal Muskoka" air was most exhilarating. Bathing, boating, fishing, tennis and golfing gave the visitors a wide assortment of amusements, and the splendid attendance of the lady members lent additional charm to the occasion. During the convention a series of festivities were carried out, including the annual banquet, a canoeing regatta, golf tournament, fishing competition and a base ball match between the manufacturers and central station operators. Perfect weather conditions prevailed throughout the entire meeting.

ELECTION OF OFFICERS.

The executive section of the convention elected officers as follows: President, Mr. P. S. Coate, manager of the Chatham Gas Company, Chatham, Ont.; first vice-president, Mr. E. A. Evans, Quebec Railway, Light & Power Company; second vice-president, Mr. W. L. Adams, Ontario Power Company, Niagara Falls, Ontario; secretary-treasurer, Mr. T. S. Young, Toronto, re-elected. Management committee: Messrs, J. J. Wright, R. G. Black, R. F. Pack, L. V. Webber, A. L. Mudge, D. H. McDougal, Toronto; W. N. Ryerson, A. A. Dion, Ottawa, F. A. Chisholm, St. Johns, Que.; W. L. Bird, Fort William.

Mr. P. S. Coate, the newly elected president of the association, has been long identified with electrical interests in Canada. He is a man of particularly affable disposition and notice of his new honor is received with little surprise by his friends.

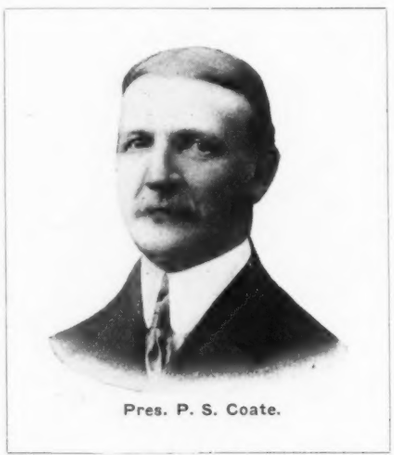
Born in Chatham, Ontario, he has been constantly engaged with the Chatham Gas Company for 26 years; rising to the position of accountant and from that to secretary of the company, until to-day he is the general manager. Besides being a large operating gas company, his Chatham plant also extensively generates and distributes electrical energy.

ANNUAL BANQUET.

The association's annual banquet held on Thursday evening was a decided success, and never, perhaps, has an assemblage of electrical engineers gathered under more happy circumstances. Mr. Frederic Nicholls replied to the toast of "Canada, Our Country," in a stirring speech; in his belief Canada is destined to become one of the greatest nations of the earth. Mr. C. A. Littlefield replied on behalf of the "Central Stations," reviewing in an excellent manner the progress made since the first central energy was supplied. "Sister Societies" was responded to by Mr. W. W. Freeman, president of the National Electric Light Association; Mr. T. C. Martin, secretary of the same association, and Mr. Charles F. Scott, ex-president American Institute of Electrical Engineers. Their remarks were enthusiastically received. All of the speakers dealt with the question of amalgamation of the Canadian Association with the larger American body. With union would come strength was the keynote running throughout their remarks. Mr. Martin spoke in flattering terms of Mr. Nicholl's work in the past in the interests of the National Electric Light Association when at its head. The toast to the ladies was replied to by Mr. W. A. Bucke, Toronto, and Mr. A. A. Dion, Ottawa. President Coate made an admirable chairman and master of ceremonies.

ASSOCIATION AFFAIRS.

On the first day the attendance was exceptionally good when the first vice-president, Mr. P. S. Coate, called the convention to order. President W. N. Ryerson, of the Great Northern



Pres. P. S. Coate.

Power Company, Duluth, Minn., sent a message expressing his regrets at his inability to be present. An interesting paper prepared by Mr. Ryerson was read later, taking the place of the usual presidential address.

After the minutes of the association had been read and approved, Secretary-Treasurer T. S. Young made his annual report. It was extensive and showed that the Canadian Electrical Association has been steadily gaining ground during the past year. The financial standing of the association is also excellent.

The chairman next read President Ryerson's paper, "Some Practical Considerations Concerning Contracts for Lighting and Motor Service." Considerable discussion followed. Mr. R. F. Pach, Toronto, considered that the enforcement of a penalty for non-payment of accounts when due, as urged by Mr. Ryerson, would antagonize the customer and advocated rather the adoption of a discount system for payments made in advance. He also took exception to the insertion of a "mutual liability" clause in motor service contracts as being of too dangerous a character.

THE COMMERCIAL AGENT AND THE COMMUNITY.

Mr. C. A. Littlefield, of the New York Edison Company, gave a brief description of the commercial department of his

company. He stated that during the year 1909 348 buildings were erected in New York City requiring electric service, and of this number 96.7 per cent adopted the central-station service. During 1909 40 isolated plants were shut down and central-station service substituted therefor. The company delivers energy to a total of 233,400 hp in motors. The commercial department work is carried on by eight bureaus known as the wholesale and new-business, private plant, motor service, sign, automobile, heating, follow-up and engineering. The company maintains five district offices, and a contract and inspection department by which all relations with the public are conducted. It has no wiring department, but co-operates with wiring contractors.

Referring briefly to the subject of rates, the author expressed the opinion that a simple, easily understood rate system devoid of "minimum," "stand-by" or "readiness-to-serve" charges is one that strongly appeals to the public. Gild the charge as one wishes with descriptive phrases, the customer is convinced when he gets a bill of this nature that he is paying for something he has not received, and no amount of argument can dispel the dissatisfaction that the bill has created. The theory upon which rates are based, sustained by precedent and a wealth of eminent authority, amply justifies the use of "stand-by" charges, but from the viewpoint of the great buying public there are most convincing arguments in opposition to these requirements in a rate, thereby placing the theory and application of rates at variance.

In response to the wishes of the association of merchants and property owners along Fifth Avenue the company has agreed not to canvass for signs along this thoroughfare and to discourage their use in that locality. As a means of attracting night crowds to the avenue the company made a trial display of window lighting on several blocks, furnishing at its own expense both the lighting equipment and the electrical energy. By this means the company has gained the good-will of the merchants and property owners.

In the discussion Mr. Littlefield was called on to answer several questions regarding the plans outlined therein. Mr. A. A. Dion expressed appreciation of the paper. He took exception to a statement made regarding "stand-by" or "readiness-to-serve" charges. He expressed the belief that the introduction of tungsten and other high-efficiency lamps renders necessary the establishment of such charges by all central stations. A general discussion followed and it was decided to give Mr. Littlefield's paper consideration when discussing rates.

THE THREE-ELEMENT RATE SYSTEM.

Mr. S. Bingham Hood, of the Toronto Electric Light Company, was the author of a paper entitled "The R. C. M. Electric Service Rate System." The system described is based on three elements of the rate, namely, the "readiness-to-serve" charge, the "consumer" charge and the "meter" charge. The first charge includes the items necessary to maintain and operate the entire generating equipment without load or actual delivery of energy to the consumer. The second charge includes all those expenses which vary directly with the number of consumers on the system. The third charge varies directly with the kw-hour output; in general, it would be divided into two parts covering the actual energy supplied and the lamp renewals, respectively.

The advantages claimed for the three-element rate system are as follows: (1) Unprofitable short-hour business is discouraged. (2) A fair and uniform profit is assured from all consumers. (3) The small consumer is given the same advantage as the large one, having equal load conditions. (4) Each consumer is given the lowest possible rate which his load conditions will warrant, irrespective of the size of his maximum peak demand. (5) Any benefit to be derived from improvements in efficiency of lighting units is shared between the consumer and the company, thereby enabling the company to adopt and push the introduction of these improved units without suffering a destructive decrease in revenue.

In the absence of Mr. Hood this paper was read by Mr. S. E. Doane, of the National Electric Lamp Association. This paper, on account of the principle of rates advocated by the author, was regarded as essentially the most important of the convention; and a spirited and energetic discussion was largely participated in by the members present. Mr. R. G. Black, general superintendent of the Toronto Electric Light Company, spoke at length. Different contracts and schedules are necessary, he said, if the central station desires to reach all classes of customers. He pointed out both advantages and disadvantages in the new system as outlined. Mr. R. F. Pack, of Toronto, feared that the advent of such a system would cause agitation. This speaker suggested that both private and municipal companies would find it advantageous to submit rates to a public-service commission for adjustment. These commissions could also assist in educating the public to an understanding of scientific lighting rates.

Mr. A. T. Holbrook, of New York, spoke to this question discussing the system proposed in city application to residential lighting. He stated that no commission would allow any lighting company to enforce the rate stipulated by Mr. Hood on the basis of carbon-lamp installation where tungsten lamps were really installed without giving the customer the benefit in connected load. On the other hand it is unfair to the company for the customer to add cooking and heating utensils without increasing the demand rates. He considered the measuring of floor area as a basis of charging quite unfair,

Mr. C. A. Littlefield, of New York, also contributed to the discussion and an interesting criticism from Mr. Peck, of Rochester, was read by the secretary.

Mr. Leonard Andrews, of London, England, criticized the paper's stand in regard to "readiness-to-serve" on the basis of floor space. He said that the light required per square foot varies with condition of room. The idea is not new, but has been tried in England. The consideration of the small customer is very necessary; he is a most valuable adjunct to the central station's prosperity. Mr. C. A. Littlefield concurred with this last remark.

RESIDENTIAL LIGHTING.

The profitable cultivation of the residential lighting field formed the subject of a paper by Mr. A. T. Holbrook, of New York, in which was given a description of the residence lighting campaign inaugurated by the Hartford Electric Light Company, which obtained 781 contracts for new installations between Sept. 1, 1909, and Feb. 1, 1910. This business was secured by means of a rate for energy based on a straight kilowatt-controlled demand charge. Careful checking in Hartford has shown that the minimum return on a kw-hour basis is 6 cents. Mr. Holbrook advocated a rate for residence lighting based on a fixed charge of not less than $120 per year per kilowatt of actual station demand. The demand should be defined by means of an excess indicator installed for the purpose. The indicator serves notice on the customer when he has exceeded his demand, and thus safeguards the lighting company against any unfair treatment on the part of the customer. This method of charging appeals especially to that class of customers whose bills average about $1.50 per month.

Under the plan here proposed the solicitor will experience no difficulty in closing contracts with owners or lessees of unwired houses. The author remarked that the lighting field can be profitably worked by co-operation with the wiring contractor and the public journals. The central station should make a rate under which results are possible. The wiring contractor should establish fixed and definite charges which can be understood by the lighting solicitor. The public journals should publish notices of general interest on lighting subjects.

In discussing Mr. Holbrook's paper, Mr. R. G. Black said that his company has for many years realized that it is not reaching the poorer class of possible customers because it did not provide a special rate that would appeal to them. It should be possible to increase largely the central-station revenue along such lines as those mentioned by Mr. Holbrook.

Mr. A. A. Dion, of Ottawa, and others contributed to the

discussion. Mr. C. A. Littlefield took issue with a statement that less than ten per cent of residences in central station centers are using electric light; he agreed, however, that a large proportion remain still unreached by the lighting companies.

Mr. I. H. Wright, of North Bay, Ont., asked the opinion of the meeting regarding the standing or rating of the small customer. It was the unanimous opinion that representing, as he generally does, the mechanic, his account is of the best nature.

The committee on central station statistics, of which Mr. W. A. Bucke was chairman, next reported. The committee was handicapped by the lack of co-operation from central station managers, who generally paid little attention to their requests for information. The committee's work during the year was commended and it will be prosecuted still further. Mr. Leonard Andrews said that information collected over a period of fifteen years in his country is now considered invaluable.

UNIFORM ACCOUNTING SYSTEM.

A committee, of which the chairman was Mr. R. F. Pack, of the Toronto Electric Light Company, presented a report endorsing the classification of accounts adopted by the National Electric Light Association. The committee said that since the Railroad and Municipal Board of Ontario has power to superintend the system of bookkeeping and keeping of accounts of all public utilities operated by municipal corporations, and, since many municipalities in Ontario will shortly be distributing energy supplied by the Hydroelectric Commission, it recommends that the Canadian Electrical Association petition the Ontario Railway and Municipal Board to adopt, and to order, a classification of accounts, for municipalities, similar to that adopted by the association.

Considerable interest was manifested in the methods outlined for adoption by central station managers.

PROTECTION OF SYSTEMS.

A paper entitled "Protection of Service in Large Electric Systems," prepared by Mr. A. S. Loizeaux, of the Consolidated Gas, Electric Light & Power Company, Baltimore, Md., was read by Mr. A. A. Dion. Emphasis was laid upon the reference in this paper to the public's appreciation of the assurance of continuity of service. In the discussion following, Mr. A. L. Mudge, of Toronto, reviewed the paper, expressing his appreciation. He said that it applies perhaps more to the larger and more complicated systems than those generally existent in Canada. Mr. Leonard Andrews discussed relays and their successful application in England.

CALCULATION OF THE REGULATION OF TRANSMISSION LINES.

A method for calculating the voltage regulation of a transmission line involving the use of certain tables of constants was described in a paper by Mr. Paul M. Lincoln, of the Westinghouse Electric & Manufacturing Company. The method ignores the effects of leakage and capacity, but takes into account the resistance and reactance of the line and the current and power-factor of the load. In applying the method the line resistance "drop" is determined by multiplying the load current by the resistance. Tables are given for showing the ratio of the reactance to the resistance at 25 cycles and 60 cycles for various sizes of wires at different spacings, and by means of this ratio the total drop is found in a third table giving a factor by which the ohmic drop must be multiplied according to the power-factor of the load and the ratio of the line reactance to the line resistance.

Mr. Lincoln not being present, Mr. C. F. Scott presented the paper and gave practical illustrations of the ease with which Mr. Lincoln's tables can be applied, by those not conversant with higher mathematics, to ascertain the size of wire required for different circuits. Mr. Scott's remarks were well received.

DISCUSSION ON AFFILIATION.

The committee appointed to investigate the question of affiliation with the National Electric Light Association reported. They were not prepared to make any decisive recommendation. Mr. Frederic Nicholls opposed the whole scheme of affiliation if they wished to remain a Canadian organization. He believed that with union would come a loss of identity and a rapid disintegration. No action was taken in the matter.

Mr. A. A. Dion, Ottawa Electric Company, as chairman of the committee on grounding of secondaries, reported. His committee was not yet prepared to make definite statements. He expressed his personal belief in grounding circuits up to the 150-volt point; beyond that, however, it should be left to the discretion of the individual as determined by local conditions. In this he disagreed with the recommendation of Dr. Steinmetz to the National Electric Light Association, who advised the grounding of all secondaries irrespective of the voltage carried.

INCREASING THE STATION LOAD.

Mr. S. G. Redway, of the Toronto Electric Light Company, presented a paper outlining certain methods for increasing the station load. The author remarked that the "take-it-or-leave-it" policy is highly disadvantageous, and the keynote of success is satisfied customers. He claimed that the central-station company, through its commercial department, should endeavor to boom the town, interest the municipal authorities to better illuminate the streets, parks and public buildings; work in harmony with the wiring and fixture contractors; try to induce electric sign makers to open factories in the territory, endeavor to get motor manufacturers to come into the cities and towns, and call upon the leading manufacturers with a view to substituting steam and gas-engine plants with up-to-date electric drive. The company should interview prospective incoming manufacturers and take an active interest in any exhibitions or fairs that may be held with the end in view of handling as much of the lighting and small motor-service business as possible.

The author described the various duties which should be performed by the members of a well-organized sales department of a progressive central-station company.

In a lively discussion following the presentation of this paper by its author, all of the speakers concurred with the suggested methods of increasing the station load.

ELECTRIC HEATING.

In his paper, "Electric Heating and Cooking Appliances," Mr. Harold S. Brown, of the Canadian General Electric Company, treated modern electrical cooking and heating appliances and gave the results of a series of experiments in which a comparison had been made with similar machines operated by gas. The economy and efficiency of the former apparatus over the others was demonstrated most fully.

WATT-HOUR METERS.

The committee on the installation, care and testing of meters, of which Mr. L. V. Webber, of the Toronto Electric Light Company, was chairman, submitted a report in which much stress was laid on the necessity for maintaining the accuracy of watt-hour meters. The opinion was expressed that it is imperative that all meters be tested systematically and regularly. Induction meters in residential districts should be tested at intervals of from 12 to 18 months; in business districts they should be tested at six-month or 12-month intervals. Commutator-type watt-hour meters in residential districts should be tested at intervals of from 6 to 12 months; in business districts the meters should be tested at intervals of from 3 to 12 months; in 500-volt industrial service the meters should be tested from three to six times per year.

Concerning the reading of meters, it was suggested that each meter be read on the same day of each month. When this plan is not followed the bills vary from month to month and the customers are displeased thereby.

ILLUMINATION AND THE CENTRAL STATION.

In a paper entitled "The Attitude of the Central-Station Manager Towards Illuminating Engineering," Mr. Roscoe Scott, of the National Electric Lamp Association, outlined some plans for the manager who wishes to introduce illuminating engineering methods into his lighting work. The author dis-

cussed the desired intensity of illumination, the diffusion, distribution and quality of light, the economical production of light and the artistic features of the lighting installation. He called attention to the value of the Illuminating Engineering Society and its *Transactions* to the central-station manager. He said that the central-station manager who takes all possible steps to have the illumination layouts on his circuits correctly designed from the standpoints of intensity, distribution, diffusion, quality, economy and artistic effect, will not need a very large complaint department. Users of other illuminants than electricity will be quick to appreciate the service which their neighbors are receiving and orders for new connections will multiply.

STREET LIGHTING WITH TUNGSTEN LAMPS.

Mr. C. E. Stephens, of the Westinghouse Electric & Manufacturing Company, read a paper entitled "The Tungsten Lamp as a Factor in Modern Street Lighting," containing a description of a constant-current regulating transformer especially designed for use with series tungsten lamps. The regulator differs from the constant-current transformer used with arc lamps in being much more sensitive and suitable for use with a circuit of constant resistance rather than one of rapidly varying resistance.

The regulating transformer is of the repulsion-coil type, there being two movable coils suspended by steel cables in such a manner that they just balance each other when the normal current exists in the secondary coil. It is said that the regulator will maintain the lamp current within 1 per cent of the normal for any load.

The paper by Mr. Stephens was read by Mr. C. F. Scott, who also contributed some useful information on the subject.

Maryland Commission News.

Messrs. Cumberland, Dugan & Son, subscribers of the Maryland Telephone Company, have preferred the charge that the Maryland Company is owned by the Chesapeake & Potomac Telephone Company, and that the latter company is operating the Maryland Company in such a manner as to compel the subscribers of the latter to become subscribers of its company. The letter containing these assertions was submitted to Mr. Charles H. Weber, division superintendent of the Chesapeake & Potomac Telephone Company. In response to various inquiries, Mr. Weber said that his company did not operate the Maryland Company, but it did guarantee the bonds of the Maryland Telephone Company and that the two companies were under separate management. The complaint was also made to the commission that the Maryland Telephone Company had not issued a directory since 1909, but this was denied at the office of the Chesapeake Company. The Public Service Commission referred this complaint to the Chesapeake & Potomac Telephone Company with a request that it be adjusted within 10 days. Messrs. Cumberland, Dugan & Son addressed their complaint to the Governor under the impression that he was a member of the Public Utilities Commission. They say that their object in making the complaint is to save the life of the Maryland Telephone Company.

Wisconsin Commission News.

The Wisconsin Rate Commission has authorized the Berlin Public Service Company, a reorganized company, to issue stock and bonds as follows:

1. Seven hundred and fifty shares of common stock of the par value of $100 per share. 2. Seventy thousand dollars par value of bonds, of denominations of $100 and $500 each. These bonds are to be issued under and pursuant to a mortgage or trust deed executed and delivered by the applicant to the Fidelity Trust Company as trustee, and are to bear interest at the rate of 5 per cent per annum.

Five shares of the capital stock are to be sold for money only, the same being a reissue of the $500 par value of stock, previously issued without the consent of the commission, which was sold for the purpose of paying the expenses of incorporation. The balance of the stock is to be issued and exchanged for an outstanding bonded indebtedness against the property purchased by the applicant company. The bonds are to be issued and exchanged to take up, pay and compromise all accounts and debts against the property and against O. C. Irwin, receiver of the Berlin Lighting, Heating & Power Company, and are to be used in connection with the bills and accounts receivable purchased with the property.

The applicant company was incorporated on May 19, 1910, for the purpose of acquiring the equity of the Berlin Lighting, Heating & Power Company, and of the receiver of said company, in and to the plant and all the property of the said company. The value of the physical property, as determined by the commission, is $127,500.

Part 3 of the third annual report of the commission, which contains the statistics of the steam and electric railroads for the year ending June 30, 1909, is ready for distribution. Because of the disparity in the size of the electric railway systems in the state it was found advisable to group them into three classes, as follows: Class A, companies whose gross earnings exceed $500,000 per year; Class B, companies whose gross earnings are between $80,000 and $500,000 per year; Class C, companies whose gross earnings are less than $80,000 per year.

A condensed summary of the income accounts for that part of the traffic lying wholly in the state is given below. There were 6 Class A, 9 Class B, and 10 Class C companies reporting.

The following average values were obtained from the statistics as reported by the various electric railway companies in the state:

Average cost of coal per ton at the plant	$3.02
Average lbs. of coal consumed per switchboard, kw-hrs. With a maximum of 11.85 and a minimum of 3.97 (Milwaukee).	6.14
Average watts per lb. of coal consumed	179.72
Average pound-Fahrenheit units per lb. of coal	12,606
Average operating expense per mile of single track, exclusive of taxes and depreciation	$3,802.80
Total number of passengers carried (in State)	142,761,892

Of the above total, 77.7 per cent were classed as revenue passengers, 21.8 per cent as transfer passengers, and 0.5 per cent as free passengers.

The report shows a total of 43 persons killed in the state by electric railways, and a total of 852 injured. Thirty-one of those killed were struck by the cars, while 33.9 per cent of the total injured received the injury in alighting from the cars, 21 per cent in getting on the cars and 13.5 per cent by collisions between cars.

New York Commission News.

The Interborough Rapid Transit Company, last week, submitted an offer to the city of New York for the operation and equipment of new subways and extensions to the existing lines, to be constructed on the city's credit at a cost of about $70,000,000. The proposal was sent to Mayor Gaynor instead of to the Public Service Commission, and it was by the Mayor forwarded to the commission. There is very little difference between the present proposal and those heretofore made by the Interborough company, with the exception that it is proposed to use Lexington Avenue instead of Madison Avenue for a north and south line. It is proposed to construct a four-track line from Times Square under Seventh Avenue and West Broadway to Liberty Street with a two-track extension to the Battery and a two-track branch from the intersection of Liberty Street and West Broadway under Liberty Street and under the East River to Pineapple Street, Brooklyn, from there to a junction with the existing Brooklyn subway on Fulton Street and a four-track extension from the terminus of the present subway at Atlantic Avenue under Atlantic Avenue and Eastern Parkway as far as Nostrand Avenue. It is proposed also to construct a four-track line from the present subway at about Thirty-fifth Street and Park Avenue under private property to Lexington Avenue, under Lexington Avenue and under the Harlem River to 149th Street in the Bronx, thence a two-track extension connecting with the present West Farms branch of the subway system and another two-track extension, principally an elevated

structure running up River and Jerome Avenues to 194th Street. The Interborough suggests that the operating lease of this proposed new line, if built, be made at least coterminous with the unexpired portion of the present subway contract. The chairman of the Public Service Commission has expressed his disapproval of the proposed plan, and declares that he does not think it is as advantageous to the city as former offers made by the Interborough Company. The plan also contains as a portion of it, as have all the other proposals of the Interborough, the right to third-track the elevated structures. The proposal to use Lexington Avenue, according to the commission's view, would effectually prevent the construction of the comprehensive tri-borough system, plans for which have already been drawn, and would practically give the Interborough Company a monopoly in rapid transit in Manhattan and the Bronx.

The commission finally completed its hearings last week upon the Third Avenue reorganization plan. These hearings have been going on for six months. Vast quantities of statistics and figures have been filed with the commission, prepared by experts employed both by the commission and the bondholders reorganization committee. The opinions of these experts as to the present physical value of the property and its replacement cost vary widely. It is not believed that a decision in this case will be reached for some weeks, and it is probable that the refinancing plan offered by the bondholders' committee will be scaled down.

It was announced last week by a member of the Public Service Commission that during the present month advertisements would probable be published asking for bids for the construction of the Broadway-Lexington Avenue subway system. The engineers are now preparing the final details of these contracts and as soon as this work is completed they will be sent to the corporation counsel for approval.

The commission has formally approved the terms of the franchise recently granted by the Board of Estimate and Apportionment to the Union Railway Company for the construction of a trolley extension from the intersection of Sedgwick Avenue and Fordham Road in the Bronx across the Harlem River Bridge at 207th Street to connect with the Third Avenue Railroad line at Emerson Street and Broadway.

The commission has ordered an inquiry to be made into the service provided and the equipment employed by the New York & Queens County Railway Company. The line complained of runs from the terminus of the Fulton Street Elevated line in Queens County to Freeport and other points in Nassau County. Charges of inefficient equipment and insufficient accommodation have been made by the patrons of the line.

Fire Commissioner Rhinelander Waldo, of New York, has sent a report to the committee of the Board of Estimate and Apportionment which is investigating the condition of the fire-alarm service in the city, recommending the abolition of the private fire-alarm companies. Mr. Waldo urges that these private alarm concerns be taken over by the city and expresses the opinion that the city would get enough rentals from them to run the entire fire-alarm telegraph system. He also says that one-half of the alarms sent in by some of these companies are unnecessary. The majority of these private concerns operate in lower Manhattan and in the dry goods district, but there are also about 1500 subscribers in Brooklyn. Mr. Waldo gives the list of companies and subscribers as follows: Automatic Fire-Alarm Company, 1233 subscribers; Consolidated Fire-Alarm Company, 346; Manhattan Fire-Alarm Company, 3322; National District Telegraph Company, 241, and Fire-Alarm Electric Signal Company, 519. These companies install alarm boxes in buildings and then run a wire connecting with the nearest city fire department line. Their fees are from $50 to $60 per year for the first box installed, with additional boxes in the same establishment at reduced cost. According to Mr. Waldo, the companies admit that they derive a revenue of about $212,000 a year in rentals, but the commissioner thinks their total receipts are in the neighborhood of $500,000.

The Public Service Commission, Second District, has received an application from the Livonia Light & Heat Company for permission and approval of the commencement of construction and the exercise of rights and privileges under a franchise granted to it by the Town Board and Highway Commissioners of the towns of Livonia, Lima and Avon, all located in Livingston County. Also, a petition from the Lima-Honeoye Electric Light & Railroad Company and the Lima-Honeoye Light Company for consent to transfer and lease property and franchises of the Lima-Honeoye Electric Light & Railroad Company to the Lima-Honeoye Light Company; and a petition from the Lima-Honeoye Light Company for an order authorizing the issue of $5,000 par value of its capital stock for the improvement and maintenance of the electrical plant, distributing system and railroad leased to it by the Lima-Honeoye Electric Light & Railroad Company.

During the present week the Public Service Commission, Second District, will give hearings on the complaint of residents of the villages of White Plains, Portchester, Eastchester and Irvington and the Public Welfare Association of the villages of Tarrytown and North Tarrytown against the Westchester Lighting Company relative to quality and price of gas and electricity, and on the application of the Suffolk Gas & Electric Light Company for authority to acquire all of the outstanding capital stock of the East Islip Electric Company and to merge said company with itself.

Massachusetts Commission News.

The Massachusetts Railroad Commission gave an important hearing on July 6 upon the petition of the Boston & Eastern Electric Railroad Company for a certificate of public convenience and necessity in connection with its plans for building a high-speed interurban railroad between Post Office Square, Boston, and the North Shore cities of Lynn and Salem, with branches to Beverly and Danvers. At the recent session of the Legislature the company was granted the right to build a tunnel under Boston Harbor and a subway in Boston to a terminus and by a route to be fixed by the Railroad and Transit Commissions. Mr. Charles Baxter requested on the ground of the board's previous intimation that there is a necessity for the construction of the line, combined with the recent legislative enactment regarding tunnel construction, that the commission issue the certificate of exigency to the railroad company. This request was vigorously opposed by Mr. Frederic E. Snow, counsel for the Boston Elevated Railway Company; Mr. Bentley W. Warren, counsel for the Boston & Northern Street Railway Company, and Mr. William H. Coolidge, counsel for the Boston & Maine Railroad Company. Other objections were voiced by Mr. Woodward Hudson, counsel for the New York Central & Hudson River Railroad Company, whose property in East Boston is crossed by the proposed road. President Melvin O. Adams, of the Boston, Revere Beach & Lynn Railroad, was also present in opposition. Mr. Snow said that the Boston Elevated Railway Company desires to handle the incoming traffic from the suburban districts of Boston, distributing it by means of its extensive elevated, subway and tunnel systems. He suggested that the transportation conditions of 1908, when the board first found that the Boston & Eastern road would be desirable, are not to-day in evidence. Since that time the Boston Elevated has rearranged its large terminal at Sullivan Square and has secured a location for its elevated extension to Malden and Everett. The Boston Elevated opposes any separate transportation lines into Boston on the ground of its present unified service and capabilities of expansion, together with its heavy investments in subways and tunnels, which must be supported by large suburban patronage no less than by city traffic.

For the Boston & Northern Street Railway Company, Mr. Warren emphasized the fact that the board had rejected the first plan of the petitioners to enter the city by Sullivan Square. He stated that the question of necessity is still open and that the conditions in the transportation field at Boston are different from those which obtained when the board gave its tentative approval to the project in 1908, and argued that the question of exigency must be determined afresh. He felt that if the road is built it will tend to delay electrification of the steam railroads on the north of Boston, and contended that the extent

of control to be exercised in the future by the Boston Elevated Railway Company in the handling of electric transportation in eastern Massachusetts is bound up with this problem of new lines. Concluding, Mr. Warren said that the Boston & Maine Railroad could not in fairness be asked to electrify its lines if the Boston & Eastern should be permitted to build an electric high-speed road in its territory.

Chairman Hall, of the commission, said that he did not see, as a practical matter, that the Boston & Eastern law of 1910 in any way requires the question of necessity to be redetermined. Speaking for himself, he implied that the necessity of the enterprise has now been shown and that the procedure henceforth should be merely routine.

Mr. William H. Coolidge, for the Boston & Maine Railroad, stated that all the existing transportation companies stand ready to electrify or otherwise improve their services, as the commission and the Legislature may require. If the Boston & Maine Railroad is required to electrify its suburban lines, the public will get exactly the same kind of a railroad as the Boston & Eastern proposes to build, including a tunnel between the two union stations at Boston, which will facilitate distribution of traffic in the city. If the Boston & Maine should be electrified and the Boston & Eastern built, there would be two electrified roads in the same territory, with duplication of facilities and investment. Mr. Coolidge cited the recent address by Mr. George Westinghouse on steam-railroad electrification and contended that this is bound to come in the near future. Since the finding of the board in 1908 the Boston & Maine and New York, New Haven & Hartford railroads have become substantially a unified transportation system for New England and the proper handling of the Boston traffic is one of the important problems before the management. The proposed inter-station tunnel will cost $15,000,000, and if this cannot be used to handle the suburban traffic electrically, and particularly the traffic originating outside the immediate metropolitan district in which the Boston Elevated operates, there will be no incentive to build it. Mr. Coolidge argued that the times have changed greatly since the first finding of the board, and that the existing companies are the ones to do new work if such is necessary.

At a continued hearing, on July 11, arguments in opposition to the project were presented by F. E. Snow, counsel for the Boston Elevated Railway Company. Mr. Snow stated that the Boston Elevated Railway Company is firmly opposed to the entrance of any competitive system of transportation into the heart of Boston, and that the company would not for a moment have considered building new rapid transit elevated and subway lines and paying charges upon them if it did not feel assured that the policy of the commission is to permit no rival agency to establish a line and central terminus in the center of distribution of the Boston territory. All the company's agreements and financing have been carried forward on the basis of a single unified electric transportation system in Boston, and a line like that of the Boston & Eastern would injure existing subway and tunnel lines, since it is competitive. If the certificate is to be issued, however, the Boston Elevated Railway Company should be the one to handle the traffic inside the city, and two plans by which this could be done were outlined by Mr. Snow. For the Boston & Eastern Company, Counsel C. S. Baxter urged that the evidence has conclusively indicated that the East Boston tunnel cannot be used by Boston Elevated surface cars and Boston & Eastern interurban trains together. Corporation Counsel T. A. Babson, of the city of Boston, urged the use of the East Boston tunnel by the new road on the ground that the present rental received from the Boston Elevated Railway Company is insufficient to meet the annual charges on the tunnel, which in large part have to be met in the form of a 1-cent toll charge for each passenger carried through the tube or riding in it. Woodward Hudson, counsel, and J. H. Heustis, general manager of the Boston and Albany division of the New York Central lines, opposed the construction of the new road in East Boston. The board continued the hearing until July 20, to permit further technical discussion to be held.

The Massachusetts Railroad Commission has issued an order granting a certificate of public convenience and necessity to the Boston & Western Electric Railroad Company, which desires to construct a high-speed interurban line between the cities of Waltham and Marlboro, with a branch line to the town of Maynard. The road will also pass through Weston, Wayland and Sudbury. The estimated cost of the line, which would be a double-track road, is $1,552,000, the larger items being: Grading, $565,070; bridges, culverts and trestles, $100,254; rails, $161,760; electric-power transmission, $124,595; power station and car house, $116,110. The promoters of the line contemplate establishing through service between Boston and Worcester by this route, including the use of the facilities to be offered by the Cambridge subway of the Boston Elevated Railway Company, and the Marlboro-Worcester connections of the Worcester Consolidated Street Railway Company. One of the most vigorous opponents of the proposed line was the Boston & Worcester Street Railway Company, which maintained that it is giving a true interurban service between the cities named in its charter and that any competitive route established would be injurious. On account of the large proportion of highway running which would be required between Boston and Worcester by the Boston & Western and its connections it is probable that the through traffic of the former will not suffer materially in case the new line is built as planned, since the running time via the Boston & Western between Boston and Worcester could only with much difficulty be made equal to that already in force on the existing system. If the Boston & Western line is constructed under the authority now granted that road new rapid transit facilities will be accorded to a large area in north-central Massachusetts.

The Massachusetts Gas & Electric Light Commission has issued an order approving the issue by the Cambridge Electric Light Company of 500 shares of new capital stock of the par value of $100 each. The board approves the issue at a price of $200 per share, as fixed by the directors of the company. The proceeds of the issue are to be applied to an enlargement of the company's generating station in Cambridge, including the purchase of a low-pressure turbine, the relocation of the switchboard, installation of a condensing plant suitable to low-pressure service, and the inauguration of special power service by underground lines to a number of large manufacturing plants in the Cambridgeport district.

CURRENT NEWS AND NOTES.

Incandescent Lamps for the Government.—The United States Treasury Department has authorized the expenditure of about $170,000 for incandescent electric lamps for the next 12 months. The prices established for the lamps are as follows, being based on 110-volt, 16-cp units: Carbon filament, 12.92 cents; graphitized filament, 14.86 cents; tantalum filament, 29.70 cents; tungsten filament, 40.68 cents. Prof. E. B. Rosa, of the Bureau of Standards, who conducted experiments for the department, reported the average life of the lamps as follows: Carbon, 400 hours; graphitized, 600 hours; tungsten and tantalum, each 800 hours. He found that the average carbon lamp consumed 3.3 watts and the tungsten 1.3 watt per candle.

Coal Land Withdrawals.—On July 7 President Taft announced that under the recent act of Congress providing for the Executive validation of withdrawals of public lands he had affirmed the withdrawal of 35,073,164 acres of coal land in Washington, Arizona, Utah, Colorado, North and South Dakota. Of this total 20,688,469 acres, comprising the withdrawals in North and South Dakota, had not previously been authorized and are new. The remainder, 14,374,695 acres, were withdrawn under the previous administration, but were considered of doubtful title. The act of President Taft merely makes the previous withdrawals legal and will prevent any question being raised in the future. Of the lands already withdrawn by President Taft the water power sites cover a total of 1,454,499 acres. The phosphate lands withdrawn total 2,594,113 acres and the petroleum lands 4,447,119 acres.

Tungsten in Washington.—Reports from Spokane state that valuable deposits of tungsten manganese ore containing 70 per cent of tungsten have been found in the Blue Grouse, six miles from Loon Lake.

Italian Hydroelectric Installation.—The Italian Electrochemical Company, of Rome, is planning to erect a 27,000-hp generating station near Torre dei Passeri (Teramo) in order to utilize two falls on the Pescara. The equipment will consist of 9000-hp Riva turbines driving Brown-Boveri generators.

A Good Day's Work in Conduit Laying.—According to the *Edison Round Table*, the largest amount of conduit construction ever done by the Commonwealth Edison Company in a single day was on June 1, 1910, when 22,005 duct-feet of conduit was installed. The number of men employed by the conduit department of the company on this day was 447.

Convention of Municipal Electricians.—The fifteenth annual convention of the International Association of Municipal Electricians will be held at Rochester Sept. 6 to 9, at which the following papers will be presented: *The Wireless Telephone and Telegraph; Lightning Protection; Mercury-Arc and Other Rectifiers; Telephone in the Fire Department; Underground Work; Marine Wireless Telegraph System.* Mr. Frank P. Foster, Corning, N. Y., is secretary of the association.

Proposed Telephone Regulation in Denver.—A resolution which has for its object the reduction of telephone rates in Denver has been introduced in the Board of Supervisors of that city. It requests the city attorney to submit not later than Aug. 1 an opinion setting forth the rights of the city in the premises. If the resolution prevails the city attorney will also inquire into the claim of the Colorado Telephone Company for a perpetual franchise. The resolution was referred to the committee on streets and alleys.

Swedish Waterpower Development.—According to United States Consul-General Winslow, of Stockholm, the power that can be developed from the waterfalls of Sweden is about 7,500,000 kw. Three-fourths of the larger falls are in Norrland. The State at present owns 277 falls. The largest fall now managed by the State is Trollhättan, the water of which is expected to produce 60,000 kw, but at present is producing only one-half of that amount. At the Porjis Falls, in northern Sweden, 37,500 kw is expected to be realized.

Modern Lighting of an Ancient City.—The ancient city of Tarsus, in Asia Minor, has recently been lighted by electricity, the power being obtained from the Cydnus River over a transmission line 1.5 miles in length. The hydroelectric equipment is designed for 1000 16-cp lamps; 450 are now used to light the streets of the city and the remainder will be furnished to private consumers. It is proposed to extend the electric lighting system to Adana and Mersine, the energy to be furnished by the Cydnus River and transmitted to these places.

Ban on Ugly Signs.—Numerous New York organizations, including the Fifth Avenue Association, Municipal Art Society, the Women's Municipal League, the City Club, the Manhattan Central Improvement Association, the Thirty-fourth Street Association, the Twenty-third Street Association, the Forty-second Street Association and the American Civic Association, have started a movement having as its object the removal of ugly signs along certain thoroughfares, especially Fifth Avenue. All of the reform organizations have been invited to join with the Fifth Avenue Association in drafting and obtaining suitable legislation against all unsightly signs on Fifth Avenue. The association has passed a resolution disapproving "of the construction and maintenance of unsightly electric or gas advertising signs, or signs of any other character, on the roofs, or against the walls, or affixed to any part of the premises of buildings on Fifth Avenue, or immediately adjacent thereto."

Telephone Improvements on Isthmus of Panama.—The telephone exchanges at Culebra and Paraiso, in the Canal Zone, are to be consolidated with the Empire exchange as soon as the work of installing new equipment at Empire is completed. The "central" at Paraiso has been abolished, and the stations served by it were temporarily connected with the Culebra exchange. The consolidation is designed to increase the efficiency of the service by centering operations at a point where they can be given closer supervision. A saving in operating expenses will also be effected. The new equipment at Empire will include a modern common-battery, two-section switchboard to serve 400 stations.

Chicago Subway Project.—At the meeting of the Chicago City Council on July 5 action was taken in relation to the construction of the proposed subway under downtown streets for passenger traffic and the accommodation of underground utilities, by referring the status of the subway proposition to the local transportation committee. The chairman of the committee announced that the report of Mr. Bion J. Arnold, the city's subway engineer, would not be ready before fall. A resolution expressing the sense of the Council in opposition to the Union Elevated Loop, particularly against an enlargement of the Loop district and the renewal of Loop franchises, was also referred to the local transportation committee. Mr. George W. Jackson, Inc., has submitted to the city authorities its patented plan for building a subway without interfering with the traffic on the streets.

New Jersey Public Utilities Commission.—In accordance with an act passed at the last session of the New Jersey Legislature, the State Railroad Board has passed out of existence, its three members becoming a new Public Utilities Commission. As previously noted (March 31) the commission has jurisdiction over every public-service corporation in the State, including telegraph and telephone companies, pipe lines and water companies. While very limited in its powers as compared with other State public service commissions, it can require every public utility corporation to comply with the laws of the State, to furnish safe and adequate service, to adopt a uniform system of accounting, and direct any utility corporation granting any rebates or unjust or unfair or unreasonable discriminations to cease immediately. There is right of appeal from any order of the commission. All issues of stocks and bonds must first be approved by the commission, and no lease, merger or consolidation of public utility corporations will be valid until approved by it. The expenses of the commission are limited to $50,000 per year.

Chicago Agitation of Railroad Terminal Electrification.—While there has been a lull in the agitation in Chicago for the electrification of the suburban service of the Illinois Central Railroad, there are indications that the protests from press and people are about to be revived. The Chicago *Daily Tribune* of July 7 published a strong editorial in which it declares that Chicago should no longer endure the public nuisance maintained under the title and authority of the Illinois Central Railroad. The fouling of the air with soot, gas and cinders should be stopped and electrification should be compelled. Even if it were true, which it is not, that electrification is an experiment, why has Chicago not as much right to demand progressive experimentation by its public utilities as New York? The *Tribune* announced that two weeks from the date of its editorial it will review the situation again and that twice a month or oftener the subject will be brought emphatically to the attention of its readers. No newspaper alone can win such a struggle, it is said, and the people are appealed to to win their own fight. In another column Mr. Burt L. Taylor, the clever "Line-o-Type" man of the *Tribune*, contributes caustic comment by saying: "The I. C. is all ready to electrify; all that's needed is a club." Meantime the project of compelling the electrification of the steam railroad terminals in Chicago by municipal action rests peacefully in the custody of the local transportation committee of the City Council.

Argentine-European Cable.—The direct telegraph cable from Argentina to Europe by way of Ascension Island has been opened to the public.

Large Mileage for an Electric Vehicle.—Dr. A. E. Evans, of Columbus, Ohio, has made the statement that he has used an electric vehicle (Studebaker) from April, 1905, to the present year, during which period it made a speedometer record of 87,715 miles.

Meter Tests.—Public Service Commission tests of meters in New York City during the month of June showed that 41.6 per cent of gas meters tested ran too fast and 15 per cent too slow. The corresponding figures for electric meters are 17 per cent and 12.8 per cent.

Extension of Wireless on Vessels.—It is estimated at the United States Bureau of Navigation that about 60 per cent of all steamers which will come under the law requiring them to be equipped with wireless telegraph apparatus before July 1, 1911, are already supplied with the necessary equipment.

Belgian Telegraph and Telephone Service.—Statistics show that the number of telegrams sent in Belgium in 1908 was 3,576,539, the recipts from which were $397,110; also 3,325,856 international telegrams, the receipts from which were $512,587. The telephone service gave a revenue of $1,847,590 from 34,027 telephone subscribers and 199 public telephone stations.

Ungrounded Wireless.—Experiments with a Wright aeroplane are being conducted at Fort Sam Houston, Tex., on behalf of the Government by Lieut. Ben D. Foulois. The aeroplane has been equipped with wireless telegraphy outfit and will carry on its long-distance flights an operator who will keep the local wireless station advised of the progress of the trip.

Everybody Busy at Hastings.—The enterprising Thornapple Gas & Electric Company, of Hastings, Mich., of which Mr. L. W. Heath is manager, is busy with improvements. It is just finishing a new steam-generating station to be used as a reserve to its hydroelectric plants. A new gas plant has also just been completed, and about 21 miles of aluminum transmission line is to be replaced with copper at once.

Montreal Street Lighting.—The City Council of Montreal, Quebec, Canada, acting on a report of the board of control, has decided to terminate further street-lighting arrangements with the Montreal Light, Heat & Power Company on Oct. 31 next. It will now be absolutely necessary for the City Council to make arrangements with other companies for the lighting of the streets after that date, or the city will be in darkness.

Conservation Publicity in California.—Mr. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, of San Francisco, has recently been delivering illustrated lectures to irrigation water consumers in Placer County, California, his object being to come to a better understanding with the people, and to show consumers that it is to their interests as well as that of the corporation to conserve the water supply from now until the rainy season starts in.

Proposed Baltimore Sewage-Electric Plant.—Chief Engineer Hendrick, of the Baltimore Sewerage Commission, has submitted a plan whereby, it is claimed, the public buildings of Baltimore can be lighted from an electric plant forming part of the sewage-disposal plant to be erected at Back River. The power would be generated by turbines operated by the flow of the sewage. After the sewage passes through the various tanks the water will flow off an elevation of 18 ft. into Back River, and Chief Engineer Hendrick recommends that the energy from this drop be utilized for the generation of electrical energy. The commission has directed that the plan be incorporated into the general plans of the sewage work.

Convention of Smoke Inspectors.—The fifth annual convention of the International Association for the Prevention of Smoke, an organization of the smoke inspectors of American and Canadian cities, was held at Minneapolis June 29 to July 1, inclusive. About 15 cities were represented by officials of their inspection departments. Special appliances and methods of furnace construction for avoiding smoke received the major part of the attention at the sessions. A discussion advocating the electrification of railroad terminals as a preventive of much of the smoke in large cities and railroad centers was led by the smoke inspectors of Chicago and Milwaukee. Following the technical sessions of the association, Mr. Paul P. Bird, smoke inspector of the city of Chicago, was elected president and Mr. R. C. Harris, commissioner of properties, of Toronto, Canada, was chosen secretary and treasurer.

Telephone Rate Regulation in Chicago.—Under the direction of a subcommittee of the committee on gas, oil and electric light of the City Council of Chicago, the staff of experts retained to analyze the Jackson-Young report on the telephone-rate situation in Chicago has begun its work. As previously mentioned in this journal, the chief investigator is Mr. William J. Hagenah, statistician for the Wisconsin Railroad Commission. Assisting him are Mr. Charles A. Honecker, accountant, Chicago; Mr. Peter H. Schram, accountant, Milwaukee, of the Wisconsin Railroad Commission staff, and Mr. William Sloan, engineer, of Madison, Wis., also on leave of absence from the same organization. These experts will not only analyze the Jackson-Young report, but will make a careful examination of the books of the Chicago Telephone Company and also investigate the cost of the company's plant used in furnishing telephone service in Chicago. The cost of furnishing service from this plant will be obtained from an analysis of the company's operating expenses for a reasonable period of time, probably two years. No doubt, also, allowance will be made for depreciation, and it will be interesting to observe whether the conclusions of the Jackson-Young report are followed in this particular. When the subcommittee's experts have made their report the aldermen will take up the actual question of revising the rates for telephone service as required by the ordinance under which the company is operating.

Toronto Central Station Situation.—The offer of the Toronto Electric Light Company to the corporation of the city of Toronto, looking to the elimination of competition between the company and the new civic electrical system which will soon be receiving and distributing Niagara energy from the Hydroelectric Power Commission, was considered by the board of control for the municipality on June 30, and rejected. The board suggested that the only basis on which negotiations could be entered into by the city corporation was the sale of the company's plant to the city at a reasonable figure. The counsel for the company stated that his instructions from the company had not anticipated negotiations with the city on this line, but he promised to confer with the company and see if some offer could be made by the company which would form a basis of negotiations. The offer of the Toronto Electric Light Company, made on June 8, was given in these columns in the issue of June 16. Briefly, the company proposed that the corporation should utilize the Hydroelectric Power Commission's energy to the extent of 6000 hp, but to do so only for the purposes of water-works pumping, street lighting and lighting of municipal buildings; the city and company to have the joint use of the poles and conduits throughout the city; the rates to be fixed by the city and company and the dividends to be 10 per cent on the capital stock, the Mayor being an ex-officio member of the board of directors. It was claimed by the company that the city would be saved an expenditure of about $5,000,000 as a result of the abandonment of the duplicate plant.

Wires from Reno Carried 800,000 Words.—Officers of both the Western Union and the Postal Telegraph companies have stated that the sending of fight news out of Reno broke all telegraph records for a single day. More than 800,000 words were sent at an average cost of 2 cents a word.

British Decision Against Municipal Trading.—A British court has decided that municipal lighting plants, in the absence of parliamentary authority, have not the right to wire houses and supply fittings and electrical appliances to consumers. The installation of electric fittings was held to be a separate business incidental to the use, but not the supply, of electricity.

Telephone Company Fined $175,000.—Judge Blount, in the Chancery Court at Water Valley, Miss., imposed a fine of $175,000 for violation of the State anti-trust law upon the Cumberland Telephone & Telegraph Company. The company was charged with entering into a contract with the Oxford Telephone Company in Marshall County for the purpose of shutting off competition.

Telephone Regulation in Mississippi.—The Cumberland Telephone & Telegraph Company has been found guilty of violating the Mississippi State anti-trust law by Judge I. T. Blount in the Chancery Court and a fine of $175,000 has been imposed. The company was charged with entering into a contract with the Oxford Telephone Company in Marshall County for the purpose of shutting off competition. The case will be appealed.

Texas Telephone Regulation.—The Texas State Court of Civil Appeals has upheld the city of Dallas in a case appealed by the Southwestern Telephone Company, attacking the constitutionality of the initiative and referendum ordinance, passed at the city election last April. The ordinance fixes the rates of charges, prohibits the telephone company from collecting in advance for rentals, and gives subscribers 10 per cent discount on bills if paid by the 10th day of the month following service.

Railway Regulation in Illinois.—The Supreme Court of Illinois has decided in favor of Mr. Clarence H. Venner, in his mandamus proceedings against the Chicago City Railway Company for inspection of its books of account and records, and reversed the decision of the Appellate Court, which was in favor of the railway company. The company contended that it was not subject to the general corporation law entitling stockholders to such inspection, because it was incorporated by special charter before the corporation law was passed. This contention the Supreme Court has overruled.

Turkey Wants Electric Railways.—Following close on the concession granted to the telephone syndicate for the exclusive operation of telephones in Constantinople, as announced in these columns a few weeks ago, comes the invitation to Americans from the Ottoman Government, through its consul-general in New York, to build electric railways in the capital. There is to be a network in the city itself and besides this the Government has laid out five possible routes outside Constantinople. The Turks are also asking for bids on a system of trolley roads in the city of Salonica. The bids close on Nov. 1.

Northern California 27,000-HP Plant.—On June 19 the Northern California Power Company began the operation of its Inskip generating station near Redding, thereby adding 8000 hp to its generating capacity, which now has a total of 27,000 hp, as follows: Volta power house, 9000 hp; Kilare power house, 4000 hp; South power house, 6000 hp; Inskip power house, 8000 hp. The company has commenced to build a power house on Battle Creek at Coleman, three miles from the junction of the creek with the Sacramento River, at which point 20,000 hp will be developed under a head of 480 ft.

Increasing Use of Electricity on Passenger Trains.—All the through trains of the Burlington system are now lighted by electricity from the locomotive to the observation platform. No such extensive and costly improvement of coach lighting has been attempted before. These electric-lighted trains run between Chicago, St. Louis, St. Paul, Omaha, Kansas City, Denver, Billings, Spokane, Seattle, Tacoma and Portland. The generator is located in the baggage car and an electrician is on duty on each train.

Cable Letters.—As a result of closer business relations between the Western Union Telegraph Company, the Anglo-American Telegraph Company and the Direct United States Cable Company, it is expected that a plan will be put in force for sending cable messages between certain hours at greatly reduced rates. The plan is said to be similar to the "night letter" telegram idea recently adopted by the land telegraph companies. It is thought that by establishing a lower rate between certain hours for messages sent in ordinary words rather than in code a great increase will result in the service by encouraging the sending of messages of a social or domestic nature from continent to continent, which are now seldom sent, owing to the high tolls.

Chicago Subway Plans.—Mr. Bion J. Arnold has taken charge of the plans of the proposed State Street passenger subway system and will report his recommendations to the City Council some time in the fall. The line will be a four-track road under State Street from Chicago Avenue to Twenty-third Street, the estimated cost being about $5,000,000. It is said that Mr. Arnold will also advise that the conduits of the public service corporations be removed from the streets entirely and placed in the alleys back of the buildings that are supplied. It will be suggested that the subway extend from building line to building line and that there be underground sidewalks with store entrances and shop windows. A storage yard for cars under Grant Park, in the downtown district, is one feature of the plan. This would do away with the dead haul of empty cars back to the yards after the morning rush and again down town before the evening rush. It is now believed that work on this subway can be started early next year and that it can be completed within three years.

Denver Gas and Electric Banquet.—The third annual banquet of the Denver Gas & Electric Company, at which the guests were 100 office employees, was given June 18. Mr. F. M. Willoughby was toastmaster, and responses were made by Messrs. T. L. Curtan, L. A. Ramsey, C. C. Van Vlaack, George Creel, of the Denver *Post*, and Charles H. Elliott. The Denver *Post* of June 20 contained a leading editorial by Mr. Creel in which he referred in high terms to the policy of the company towards its employees and the public. "Speech after speech was made—all of them splendid, too," he said, "amply recognizing the right of the consumer to every courtesy and consideration; and from conversation it was learned that the banquet was really a sort of 'commencement,' marking the end of a lecture and study course that has for its sole object the education of the corporation employees with regard to their public relations and right and proper dealing with the people. In this course that the company provides for its men, the text-books are individuals, and the lectures do not deal with abstractions, but center about the consumer, his rights, his treatment and his point of view. And the result was apparent in the high class of the hundred-odd men about the table, their intelligence, poise and general likability. And a further result is evidenced by the company's freedom from the perpetual turmoil that involves tramway, water and railway companies." In conclusion Mr. Creel recommends that the company shall, in order to allay remaining friction, demand that the city appoint meter inspectors. The Denver city government has not followed the lead of other municipalities in having a bureau of meter inspectors, and he thinks the company can do no more popular thing than to make such a demand.

A LONDON MUNICIPAL CENTRAL STATION.

Generating Station of the Westminster Electric Supply Corporation.

BY the London County Council Act, 1 0, the council was empowered to obtain possession of the site of the Millbank Street station of the Westminster Electric Supply Corporation in connection with proposed improvements, including the construction of an embankment. By the terms of the act the London County Council had to provide a new station site, and after lengthy negotiations a plot on Horseferry Road was offered to the company. This site, although much larger than the Millbank Street site, had the disadvantages that it was no longer possible to obtain coal by water, or to dispose of ashes except by means of carting, while water for condensing purposes was not so easily obtained as on the former site, which was close to the Thames River.

The London County Council, therefore, agreed to pay the Westminster Electric Supply Corporation a sum representing the difference between the cost of coal delivered at Horseferry Road and of coal brought by barges to the Millbank Street site. This agreement remains in force until 1931, when the electricity undertaking becomes purchasable by the Council. The Council also arranged to construct a subway, and to lay four 20-in. pipes from the new generating station to the river so that water for condensing purposes would be available from that source.

The arrangements in connection with this supply of water are probably the most interesting feature of the new station. There are no grids at the intake on the bed of the river, all the strainers being situated in the power house. The four pipes are of slightly different lengths, so that the hot discharge from any pipe is not liable to enter other pipes through which cold water is flowing. Grids, comprising bars spaced about 7/8 in. apart, are fixed at the station on each of the four pipes, and a very ingenious system has been adopted for minimizing trouble due to the choking of the grids and pipes. All the discharge from the condensers is passed through one tube, while the other three can, if necessary, be used for the intake. This results in the discharge pipe and grid being well scoured out due to the high velocity of the discharge water. When the pressure gages show that any intake pipe is becoming choked, that pipe is used for the discharge from the condensers and the pipe previously used for the discharge, and which has become cleared from deposit, is utilized for the intake. By changing over in this way it is possible to keep the pipes in a satisfactory condition, and to prevent a great deal of the trouble likely to arise where river water containing foreign matter is used for condensing purposes.

The water is drawn from the river by three electrically driven pumps, and after passing through the grids and through these pumps, the water flows through a rotary strainer, of which there are two installed. The unstrained water passes through a slowly revolving grid on its way to the condensers, while the discharge flows through a grid in the opposite direction, thus washing away any deposit clinging to the strainer surface. The grid is rotated at a speed of about ½ r.p.m. Each strainer is capable of dealing with 335,000 gal. of water per hour normally, and not less than about 500,000 gal. per hour in an emergency. The strainer consists of a cast-iron casing in four parts, the casing being mounted upon a sub-

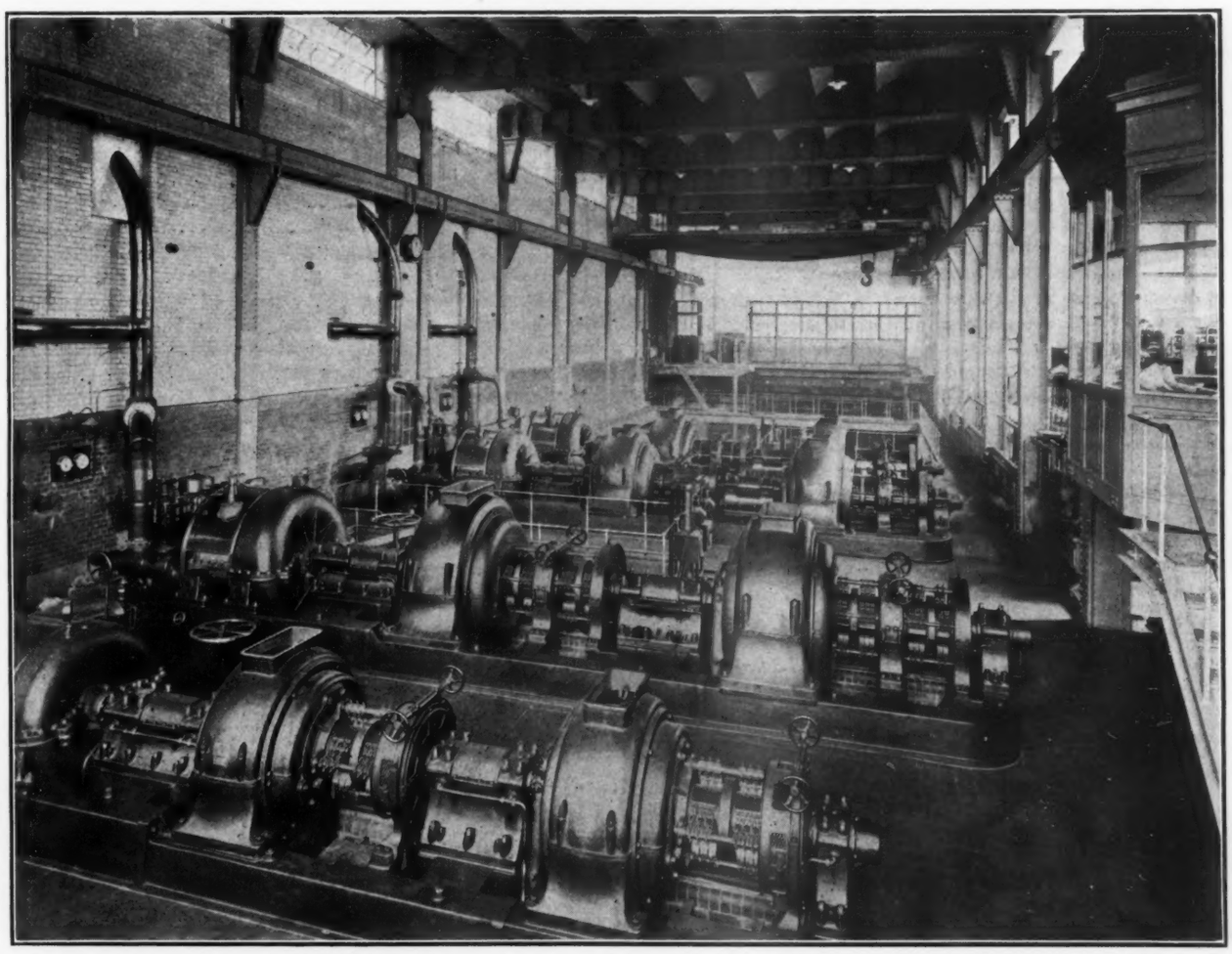


Fig. 1—Horseferry Road Station of Westminster Electric Supply Corporation.

stantial cast-iron base and provided with 18-in. inlets and outlets. Internally it is fitted with two rubbing strips faced together back and front. An inspection cover is located on the outside circumference of the top casing, while side inspection is provided for by four inspection blank covers. The cast-iron rotor, about 60 in. in diameter, is fitted with specially constructed brass grids, and is mounted upon a main shaft 5 in. in diameter, with gun-metal and leather packing rings ar-

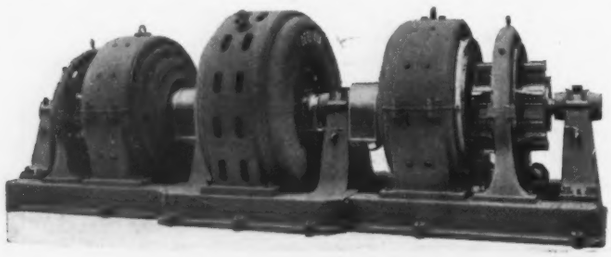


Fig. 2—Motor-Generator.

ranged to prevent the by-passing of water as far as possible, and also to allow of easy access for overhauling and repairs. A 1-in. water service for maintaining the water seal is provided, and the quantity of sealing water for each strainer amounts to about 400 gal. per hour.

Since at low tide the pumps are from 8 ft. to 10 ft. above the level of the Thames, it is evident that great care must be taken to obviate trouble due to air accumulating at the highest points in the pipes, thus causing the pumps to lose their suction. For preventing air pockets in condensing-water pipes separate 1½-in. vacuum pipes are led from all high points into a vacuum tank on the roof of the station and at a height of 70 ft. above the condensers. To this tank a vacuum pump is connected. Each vacuum pipe thus forms a barometric leg in which the water rises, and all air is collected in the vacuum tank. To prevent any water from accumulating in the latter a barometric drain pipe is provided.

Coal and ashes are brought to and removed from the station in carts. The coal is tipped from carts at the roadway into a hopper on the basement floor. From this hopper a continuous conveyor of the swinging-bucket type raises the fuel and conveys it into bunkers over the boiler house; measuring hoppers and chutes being provided for each boiler. The conveyor is capable of disposing of about 25 tons of coal per hour, and is driven by an enclosed motor. The parts of the conveyer system outside the building are covered in and protected by a frame work of steel plates. The ash conveyer lifts, at a rate of about 50 ft. per minute, a skip containing 40 cu. ft. of wet ashes from the basement outside the boiler house to an ash bunker overhead, whence the ashes are discharged through chutes to carts. The ash conveyer is driven by a series-wound, direct-current enclosed motor. Each ash skip is brought out on a trolley, which runs on rails on the boiler-room basement floor.

As in the case of the Millbank Street station, which was shut down and handed over to the Council on May 1, the Horseferry Road station houses a low-tension direct-current system only, although several motor-generator sets are installed in which high-tension, three-phase current supplied from the Grove Road station of the Central Electric Supply Company is converted into direct current, the motor-generator sets operating in parallel with the main generators.

The boiler room houses four B. & W. boilers, each of which is fitted with a superheater and operated in connection with an economizer. Each boiler fitted as above is capable of evaporating normally 20,000 lb. of water per hour from a temperature of 75 deg. Fahr. into steam at a pressure of 200 lb. and superheated 150 deg. If necessary, each boiler can be forced to evaporate 25,000 lb. of water per hour. The superheaters are of the usual B. & W. type, consisting of solid-drawn mild-steel tubes, 1½ in. external diameter, bent to shape and expanded at the ends with wrought-steel boxes The boiler furnaces are equipped with B. & W. mechanical chain grate stokers. These are of the latest pattern, in which the movement of the grate is continuous, differing in this respect from earlier patterns, where a ratchet and pawl drive was adopted. The links are also placed closer together, which fact, together with a steady movement, allows a cheaper grade of coal to be burned. The speed of the grate is variable to suit different classes of fuel and conditions of firing, while the hopper is so arranged that the fuel is spread over the width of the grate, the thickness of the fire being regulated by a vertical movement of the fire. Shafting for driving the stokers extends the length of the boiler house, and an electric motor is installed at each end, a clutch disconnecting either motor as required.

Water for the boilers is supplied by two feed pumps and an electrically driven centrifugal pump, each capable of delivering 60,000 lb. of water per hour against a boiler pressure of 210 lb. The electrically driven centrifugal pump is found to be the more economical, but the steam pumps will generally be employed, since the exhaust steam from these pumps is taken to a feed-water heater, so that the feed water may be raised in temperature before it enters the economizer.

The vertical-spindle electrically driven turbine pump affords an interesting example of the advance made in recent years in the application of this class of pump to power-station work. From considerations of practical utility, the arrangement of the pump and motor with the axis of rotation vertical and direct coupled is one that obviously has much to commend it, as it enables the pump to be placed at as low a level as may be desired, thus avoiding the troubles so often encountered when a centrifugal pump has to work with a considerable lift on the suction side. The motor can also be placed on the engine or pump-room floor level in an easily accessible position, and well away from all danger from water. In the early days of electrical driving this arrangement was attempted, but met with little success owing chiefly to the difficulties experienced with the balancing of the vertical forces and from objectionable shaft vibrations, not to mention difficulties in connection with bearings. A water-treating and filtering plant has been installed for softening the make-up water for the boilers, and water recorders, one measuring the hot-water discharge and the other the make-up water, are also installed. A CO_2 recorder is installed in connection with the boilers.

The plant has three vertical pumps with motors and switchgear. The smallest of these is a hot-water pump capable of delivering 100 gal. per minute against a head of 45 ft., with an efficiency of 60 per cent when running at 1600 r.p.m. It

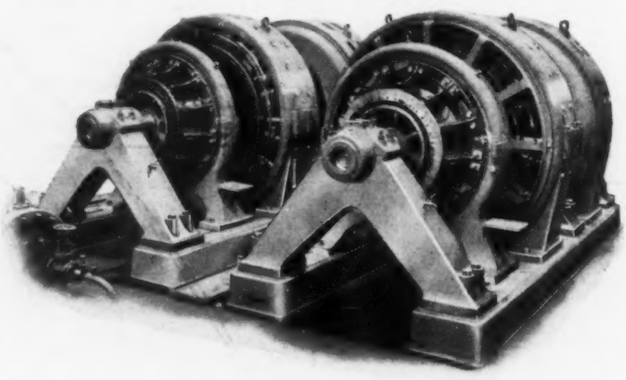


Fig. 3—Motor-Generator Sets.

is placed in the basement of the building below the water level of the hot-water sump, and is direct-coupled through a length of shaft of about 12 ft. to an electric motor of 2.8-kw rating located on the engine-room floor. The armature runs entirely in ball bearings, the topmost bearing being of the ball-thrust type and carrying the weight of the armature. At about the floor level, and within the motor casing, is a flexible shaft coupling capable of transmitting rotational forces only. Situated immediately below this coupling in an extension of the

motor housing is a ball-thrust bearing designed to carry the weight of the shafting and the pump impeller. The various lengths of shafting are connected by ordinary flange couplings, and supported laterally by ordinary white-metal bearings in halves. The pump is of the turbine type, having one impeller and one set of diffuser blades, both of special bronze. An automatic hydraulic balancing device is employed to carry the weight of the rotating parts of the pump and part of the weight of the vertical shafting.

The second pump, which is of the two-stage turbine pump type, is driven by a 5.6-kw motor located on the boiler-room floor and is designed to deliver 100 gal. of water per minute against a head of 100 ft., with an efficiency of 61 per cent when running at 1600 r.p.m. The third, and most interesting pump of the series, is the centrifugal boiler-feed pump, which is of the six-stage type, the general design and arrangement being very similar to the pumps just described. It is designed to deliver 100 gal. of water a minute against a head of 485 ft., when running at 2200 r.p.m., and with an efficiency of 61 per cent. The pump, which is illustrated in Fig. 6, is direct-connected to a 22.8-kw shunt-wound motor through a length of 8-ft. shafting. This set on test gave an efficiency of 63 per cent under the specified conditions.

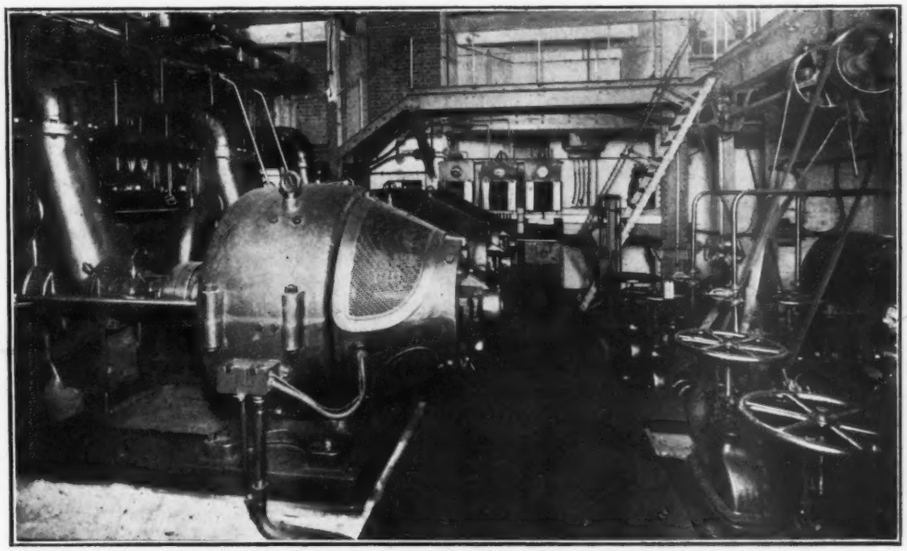


Fig. 4—Strainers and Pumps.

The main generating plant comprises three 1000-kw turbines, built by Messrs. Howden Brothers, each of which is coupled to two 500-kw direct-current generators wound for 410-460 volts, and built by Siemens Brothers Dynamo Works. In addition there are two 300-kw steam balancers of the same type as the main set, each driving two 150-kw, 200-230-volt generators. A view of the engine room, with one of the balancers in the foreground, is shown in Fig. 1.

The turbines are of the Zoelly impulse type, the larger set running at 1850 r.p.m. and the steam consumption being guaranteed with 150-deg. superheat and 28.5 in. vacuum as follows: Full load, 17.1 lb.; three-quarter load, 18.4 lb.; one-half load, 20.8 lb.; one-quarter load, 27.4 lb. per kw-hour. The corresponding figures for the 300-kw set are: 19.56 lb., 21.75 lb., 25.75 lb. and 36.75 lb. per kw-hour. In each case the plant can take an overload of 25 per cent for half an hour and 40 per cent for three minutes. The turbines are also specified to give normal full load when running non-condensing and exhausting direct to atmosphere. As indicated above, each turbine is direct-connected to two dynamos in tandem, this arrangement being considered by the engineers to be more reliable at the present time than single generators of double output. Particular attention has been paid by the manufacturers to compensating armature reaction, two commutating poles, as well as a distributed compensating winding on the main poles, being provided. As will be seen by reference to Fig. 1 each commutator is divided into two distinct parts, and the connections between the two parts are arranged to act as a fan for ventilating the interior of the commutators. The machines themselves are ventilated by fans on the armature shafting, the hot air being discharged through an opening at the top of the frame. The machines are self-excited and the pressure is regulated by hand, an adjustable rheostat being inserted in the field circuits.

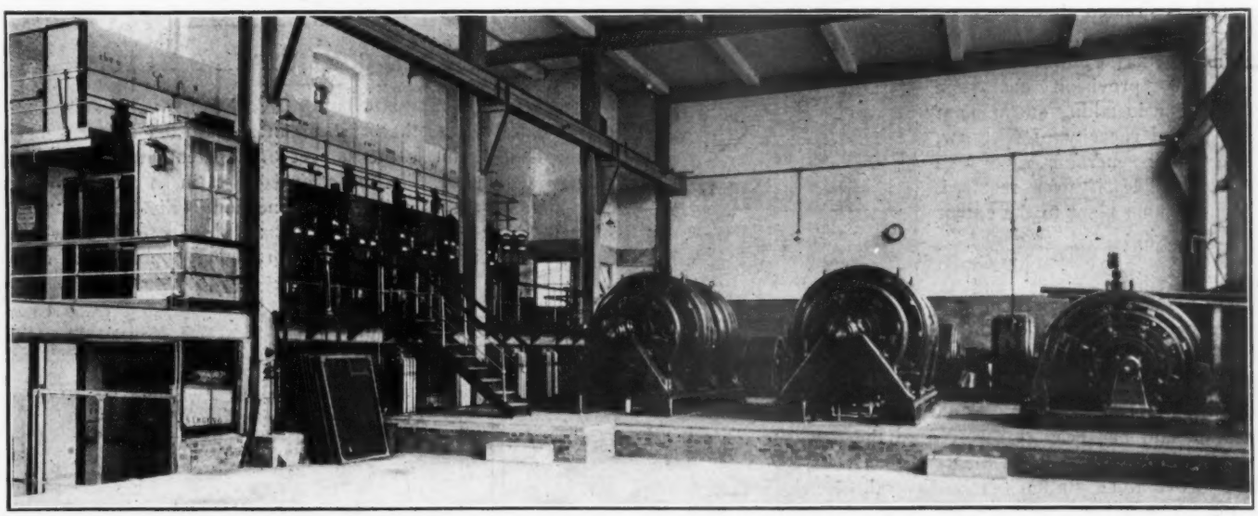


Fig. 5—Motor-Generator Room and High and Low-Tension Switchboards.

The condensers, which are situated beneath the turbines, are of the "Contraflo" type. The air pumps are electrically driven. Careful provision has been made for keeping account of all water used, and for ascertaining the cause of any undue consumption. Lea recorders are employed for the air-pump dis-

charge and for the make-up water; a Kennedy meter measures the feed water, and a Venturi meter enables the amount of condensing water to be ascertained. Three "Aero" recorders indicate the level of the water in the storage tank on the roof, in the treated-water tank and in the hot well. The make-up water is obtained from a well in the station, the city water supply being used only as a standby. A 25-ton electric crane spans the engine room, and one of smaller size is installed in the motor-generator room. An electrically driven air compressor has been found convenient for cleaning the generators, economizer tubes, etc.

Two storage batteries, each containing 100 cells, are installed in a room adjacent to the motor-generator room. The normal capacity of the batteries, which have been supplied by the Tudor Accumulator Company, is 2100 amp-hours on the one-hour rate, and they are capable of discharging at 1200 amp for two hours, or 950 amp for three hours. For charging and discharging the cells in each battery two boosters have been installed in the motor-generator room. The pressure of these boosters is regulated by hand from the main switchboard gallery in the engine room. The five end cells of each battery can also be used for regulating purposes.

As direct current is supplied from the Horseferry Road station on the three-wire system at a declared pressure of 400 volts across the outers, it is evident that the batteries act as a stand-by; but, of course, it would usually only be capable of dealing with a small part of the load. In this connection it may be mentioned that the Houses of Parliament are supplied from this station, a special panel on the switchboard controlling the supply. The batteries also serve as a standby for the various motors driving the auxiliary plant in the station.

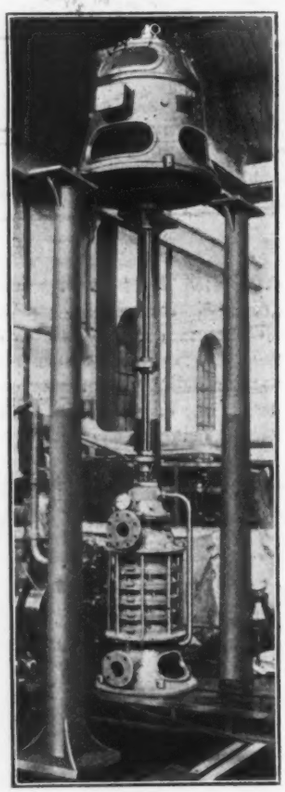


Fig. 6—Centrifugal Boiler Feed Pump and Motor.

Undoubtedly one of the most interesting features of the new station of the Westminster Electric Supply Corporation is the large motor-generator room, which is situated above the main engine room, and is of about the same size as the latter. Whereas, however, provision has been made for installing steam plant to a total capacity of 6600 kw, the motor-generator room can accommodate, if ever required, transforming plant to the extent of 15,000 kw.

At present two 1000-kw Oerlikon motor-generators and a 500-kw machine of the same type for balancing purposes have been installed, together with a 500-kw British Thomson-Houston motor-generator which was used at the Millbank Street station and has been transferred to the new site. Electrical energy is supplied to this plant at 6000 volts, 50 cycles, from the Grove Road station of the Central Electric Supply Company. The motor-generators are operated in parallel with the main steam plant installed on the ground floor, so as to obtain the most economical results.

The motor-generators can withstand an overload of 25 per cent for half an hour and a 40 per cent overload for three minutes, while they run sparkless from no load to 40 per cent overload without shifting the brushes. They are also so built that when running at normal speed they can be switched onto a short-circuited system (due to failure of the supply or defective cables). This they have to do with a current equal to 40 per cent overload and about 20 volts to start with, the pressure to be raised by regulation (separate excitation) from this level up to the normal. Even under these conditions the machines have to remain practically sparkless.

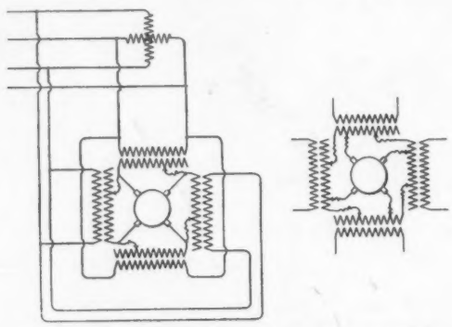
In the view of the motor-generator room given in Fig. 5 the two 1000-kw Oerlikon generators will be noticed, while the machine on the right-hand side of the illustration is the 500-kw British Thomson-Houston motor generator. In the background the balancer is just discernible, while Figs. 2 and 3 show further views of the Oerlikon machines.

The direct-current Oerlikon generators are of the auxiliary-pole type, and the commutator is equipped with shrink rings of a design similar to that adopted with most Oerlikon turbo-generators. The A-shaped spread bearings have been adopted to obtain the greatest possible stability of the machine and also to give easy and comfortable access to the commutator.

The switchgear comprises a low-tension, three-wire, direct-current switchboard in the engine room and a high-tension and low-tension switchboard in the motor-generator room. Practically the whole of the control, however, is carried out from the switch gallery in the engine room, the switches and instruments for the main generators, balancers, batteries, boosters and low-tension feeders being located on this switchboard. The arrangement of this board is on standard lines, but attention may be called to the fact that aluminum rod has been largely used for the connections behind the panels; the leads to the generators being also of aluminum rod. This allows of a very neat arrangement, and minimizes the risk of fire. Duplicate busbars are provided so that the voltage on individual feeders can be varied, while section switches allow of each busbar being divided into two independent halves. From this switchboard, which is on a gallery at one side of the engine room, as will be seen from Fig. 1, connections are run to the low-tension switchboard in the motor-generator room, a view of the high-tension and low-tension boards installed in that room being given in Fig. 5. The high-tension gear is of the standard British Thomson-Houston type, the British Thomson-Houston Company being the contractors for the whole of the switchgear. Provision is made for the necessary switching in connection with the high-tension feeders from Grove Road station and the three-phase induction motors of the motor-generators. The switches are enclosed in fire and arc-proof cells of the usual construction. Mr. G. Horley is the engineer in charge of the Horseferry Road station.

POLYPHASE COMMUTATING MOTOR.

A polyphase commutator motor, in which the value and phase of the e.m.f. across the brushes can be adjusted independently of the field circuit is the subject of a patent granted to Mr. Harris Alexander. The invention consists in so arranging the commutator brushes and their connections (Fig. 1) that they form with the rotor winding polyphase circuits, each of which comprises a set of rotor conductors lying opposite the conductors of one of the phases of the stator winding—that is, the distribution of the conductors is such that the m.m.fs. of stator and rotor are of the same shape, and leakage fields are avoided. The connections shown in Fig. 2, in addition to the above advantage, also permit the adjustment of the phase of the e.m.f.



Figs. 1 and 2—Polyphase Commutator Motors.

COLORADO HYDROELECTRIC INSTALLATION.

The Boulder Generating Station of the Central Colorado Power Company.

IN the present article will be given a description of the Boulder hydroelectric station of the Central Colorado Power Company, the other features of whose system have already been described in articles in these columns as follows: Transmission line, Jan. 27, 1910; Glenwood station, June 23, 1910; substations, June 30, 1910.

For an intelligent understanding of the Boulder development it will be necessary to repeat briefly the relation of this plant

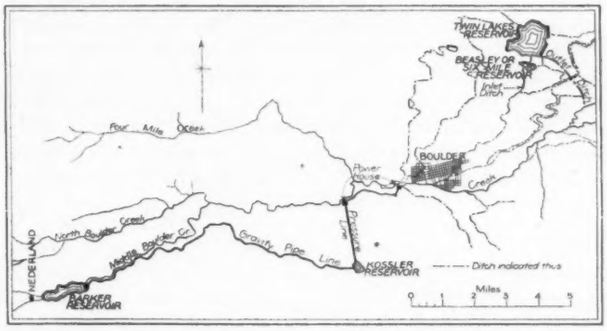


Fig. 1—Map of Colorado Hydroelectric Development.

to the other stations of the company. The Glenwood or Shoshone plant on the Grand River, near Glenwood, 153.4 miles from Denver, is designed to carry a continuous load up to 5000 kw, with very little water storage for peak-load purposes. The Boulder plant on the other hand is designed primarily as a peak-load and emergency plant, and has a very large water storage. In fact, this Boulder plant will depend almost entirely on stored water for its operation, as the minimum flow of Middle Boulder Creek, from which the supply is obtained, is as low as 5 cu. ft. per second in dry seasons. A general plan of this development is given in Fig. 1.

The Barker reservoir has a holding capacity of 520,000,000 cu. ft. It will be possible to regulate the stream with this to a continuous flow of 37 cu. ft. per second. The reservoir is provided with a concrete dam 177 ft. high. A 36-in. concrete pipe line leads from the reservoir 12 miles to a second reservoir at the head of the pressure pipe line above the power house. The plant operates under 1830 ft. static head. The power plant is rated at 10,000 kw. Below the power house on the plains is a secondary storage reservoir, in which water discharged from the plant during the winter can be stored and supplied to those having irrigation rights along the creek at such times as the primary reservoir (Barber) is storing water during the irrigation season.

The Kossler reservoir at the head of the pipe line has a present holding capacity of between 5,000,000 cu. ft. and 6,000,000 cu. ft., and when the dam contemplated is completed at this reservoir, its holding capacity will be about 9,000,000 cu. ft.

With the aid of the Kossler terminal reservoir it is estimated that the power plant can develop 15,500 hp for 100 hours, assuming the gravity pipe line between the Barker reservoir and the Kossler reservoir to be running full. Thus, in case the Glenwood power plant or the transmission line from Glenwood to Denver should fail, the Boulder plant would constitute a valuable reserve. The reservoirs also make it possible to carry high peak loads.

The Bolder plant is 29 miles from Denver, and the transmission line is erected on the plains and among the foot hills along the east side of the main range of mountains. It will not, therefore, be subject to as severe climatic conditions as will the line from Glenwood which crosses the continental divide at three different points.

Fig. 2 is a plan of the power station and Fig. 3 an elevation showing the arrangement of apparatus. Fig. 4 shows the arrangement of high-tension apparatus in this station. The station building is a brick structure with steel frame and concrete-slab roof. The reinforcing used on the roof is known as "Hy-Bib." The roof slab is 2.5 in. thick. The roof trusses are 15 ft. 4 in. apart and the purlins 5 ft. 8 in. apart. A slope of ⅝ in. to 1 ft. is given to the roof. The pressure pipe line leading into the plant is supposed to be the heaviest ever constructed. The diameter of the pipe at the lower end where the pressure is highest is 44 in. and the plates of which the pipe is constructed are 1.75 in. thick. The pipe is double-butt strap-riveted with a joint efficiency of 80 per cent. Rivets 2 in. in diameter are used. The rivet heads inside the pipe are of the flat or gas-holder type, and thus afford a smooth surface for the flow of water. The pressure pipe is laid in a trench, which averages 7 ft. wide by 11 ft. deep, and is back filled as a protection for the pipe.

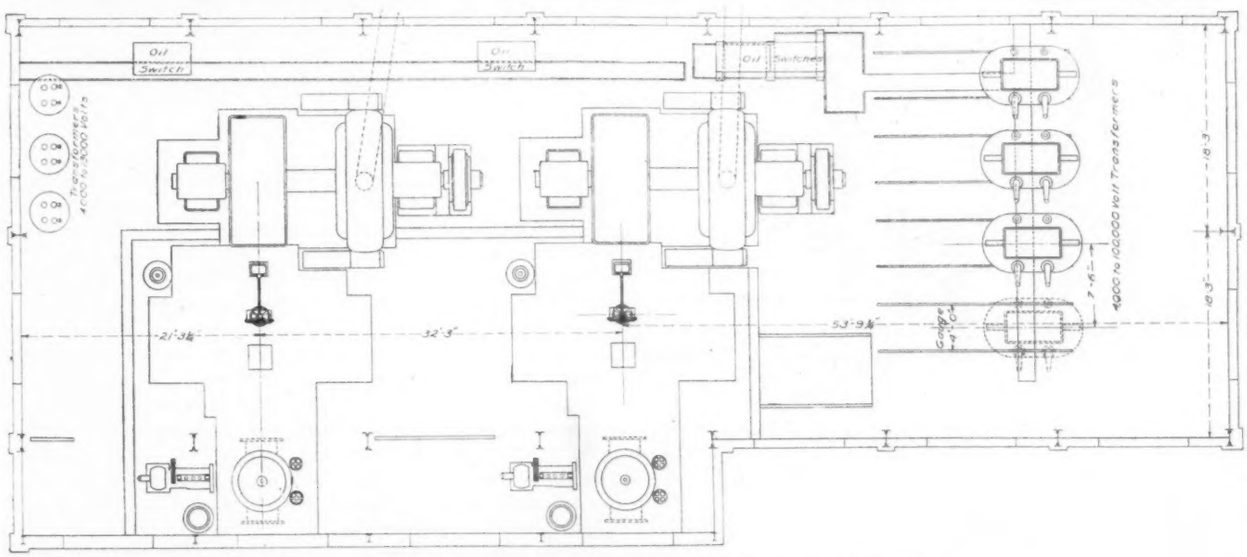


Fig. 2—Arrangement of Apparatus, Boulder Power House.

The water-wheels in the power house are of the impulse type, each of the two wheels being rated at 10,500 hp. They were furnished by the I. P. Morris Company, of Philadelphia. The governing is by deflection of the nozzles away from the wheel bucket with needle adjustment in the nozzle for different constant loads.

The electrical arrangements of the station are very simple. There are two 500-kw, three-phase generators giving 4000 volts,

60 cycles. Each generator is connected to the busbars by a 1200-amp motor-operated oil switch. The leads are in single-conductor varnished-cambric cables with waterproof braid. These are laid in fiber ducts in the concrete floor. The busbars lead through a totalizing oil switch to the transformer busbars. The oil switches are arranged along one side of the station, as seen from the plan. The transformers, which increase the e.m.f. from 4000 volts to 100,000 volts for the transmission of energy to Denver and other points on the system, are located in one end of the power house. At the other end are transformers which step up to 13,000 volts for the distribution of energy to the mining districts in the vicinity of the Boulder plant. A motor-operated oil switch is inserted in the busbars between the latter bank of transformers and the main busbars. Series instrument transformers are located under the oil switches. The shunt instrument transformers are on the wall of the station above the switches. There are three 4000-to-100,000-volt transformers connected delta. Each has a rating of 3330 kw, and a guaranteed full-load efficiency of 98.5 per cent. The voltage regulation is 1.2 per cent on non-inductive load between no-load and full-load. The transformers are rated for 24-hour run at full load with 35 deg. C. rise in temperature. For handling machinery a 35-ton Whiting motor-operated crane is installed.

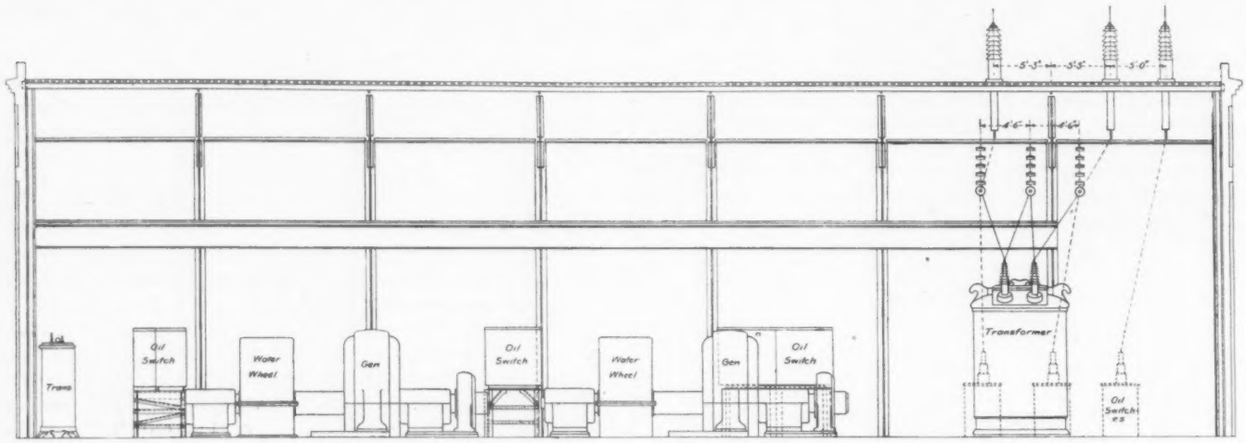


Fig. 3—Arrangement of Apparatus, Boulder Power House.

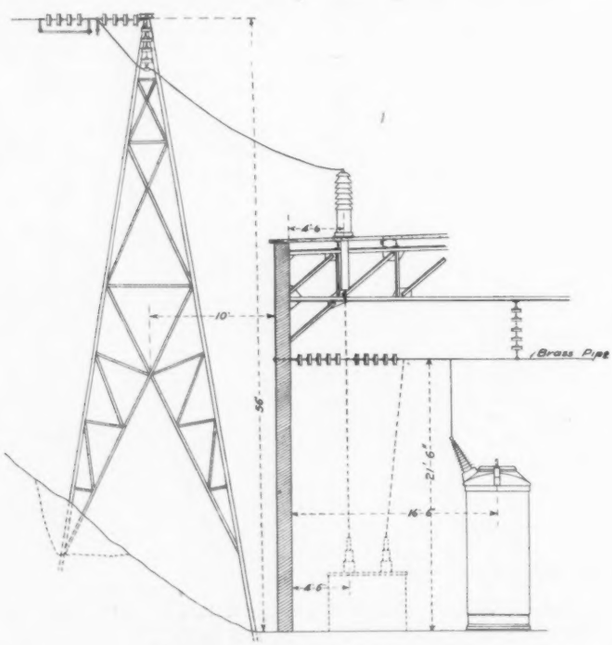


Fig. 4—High-Tension Arrangement.

The exit of the 100,000-volt lines from the building is through roof bushings such as were described in the previous articles on the Glenwood generating station and the Denver substation. The 100,000-volt bus lines inside of the building between the transformer terminals and the roof bushings consist of brass pipe of the same size as 1-in. extra-heavy iron pipe. In general, the apparatus in this station is almost a duplicate of that in the Glenwood plant already described. The essential differences between these plants are, first, the Boulder station building is a permanent and not a temporary structure; second, the Boulder plant supplies 13,000-volt energy for local distribution; third, the water-wheels are of the high-head impulse type, instead of the reaction turbine type.

CONSTRUCTION OF 135,000-VOLT TRANSMISSION INTO FLINT AND BATTLE CREEK, MICH.

The 9000-kw Cook Falls development on the Au Sable River, which is now under construction 15 miles above Au Sable, Mich., will go into operation during the coming year as the head of a 135,000-volt transmission line 125 miles to Flint, and later 65 miles further to Battle Creek, tying in at other points to the 44,000-volt network which covers south and central Michigan.

This station is the first of a series of four or five planned to develop water-power sites on the Au Sable River. It will utilize a 40-ft. fall in a wild and sparsely populated part of Iasco County. The Au Sable River has an uncommonly uniform flow, averaging 1100 cu. ft. per second. The records of 10 years show that at no season has the flood flow exceeded four times the minimum. This regularity of flow is attributable to the springs emerging from the clay strata underlying the sandy surface of the northern part of the peninsula, which supply the river, there being but two insignificant tributaries to the stream in its whole length above the water-power site.

The generating equipment will comprise three 3000-kw, 60-cycle alternators mounted on horizontal shafts driven by water-wheels, with eight runners to each shaft. The electrical output of these generators will be stepped up to 135,000 volts by delta-connected transformers installed at one end of the generator room. The dam and power-house foundation will be of solid concrete with molded water passages and draft tubes. The power house will be of brick above the water levels, and will have a floor space 40 ft. x 110 ft. The spillway section of the dam will have a total clear opening of 72 ft., given by three 24-ft. x 13-ft. Tainter gates controlled from the gate-house above the power station. The 40-ft. dam will impound a lake covering 2000 acres, which will be of use for the storage of water against daily variations in the station load. Construction work on the dam and power house has been going forward several months, and part of the concrete is already in

place. The electrical apparatus has not yet been contracted for, but all haste is being made to get the development ready for operation early next year.

The transmission line will comprise a single three-phase circuit of three No. 0 copper wires carried on suspension-type insulators hung from the cross-arms of 55-ft. tripod steel towers. These towers are generally similar to those of the 110,000-volt transmission into Grand Rapids. Two braced bracket-arms extend from one side, and one arm from the other, carrying the wires at the apices of a tipped isosceles triangle with a 12-ft. base and 17-ft. sides. The lowest wire is 40 ft. above the ground. The suspension insulators to be used will have eight disks linked in series, each disk having been tested to withstand continuously 75,000 volts, and subjected to 100,000 volts for a brief period. Each complete eight-disk insulator measures 52 in. from the tower hook to the line conductor.

The decision to employ 135,000 volts on the Cook-Flint transmission was reached only after careful study and consideration of the successful performance of the Grand Rapids 110,000-volt line. In preliminary experiments the pressure of this line has been raised to 125,000 volts, in order to determine the corona and leakage losses at pressures in excess of those commercially used. Taking the results obtained with this 50-mile line of No. 2 copper conductors, the engineers have computed that the 135,000-volt line with No. 0 conductors should show a corona loss of about 1 kw per mile. The brush display from the larger conductors at 135,000 volts should not exceed, they believe, that noticed with the No. 2 wires at 110,000 volts. The apparent power of the 135,000-volt line is expected to be between 10,000 kva and 12,000 kva for the first 125-mile section.

About 40 miles of the second section of the transmission line, from Owosso to Charlotte, is already under construction, and will be operated as part of the 44,000-volt system until the hydroelectric plant is completed. The main transmission will be tapped into substations at Flint and Saginaw. That at Flint will occupy a part of the building for the new 9000-kw steam-turbine station, which has been hastily erected to supply the demand for energy in this section. The Saginaw substation will also distribute to Bay City. Large factory installations of motors will be supplied in these vicinities. Clear rights-of-way into each substation have been purchased for the 135,000-volt lines. Rather elaborate entries are also afforded into the station transforming apparatus. The end wall of the building is apparently cut away, leaving only a hanging pediment which serves as a rain-shield to protect the vertically-downward entries of the wires through bushings in a horizontal shell carried by a second wall several feet inside the building line. The high-tension lines will be delta-connected to the transformers, subjecting the insulation to the entire 135,000-volt stress. The use of lightning arresters on this line is yet problematical, as it appears that a line of such high insulation is little injured by lightning strokes. In fact, the 110,000-volt Grand Rapids line gives less trouble than many others of much lower potential in the system, and, although afforded no lightning protection, has operated through the most severe storms without interruption. Some kind of switching apparatus will be required for handling the 135,000-volt energy at the substations, but the design of this apparatus has not been settled upon. It is understood that the large manufacurers stand ready, however, to offer switching appliances for handling this extreme voltage.

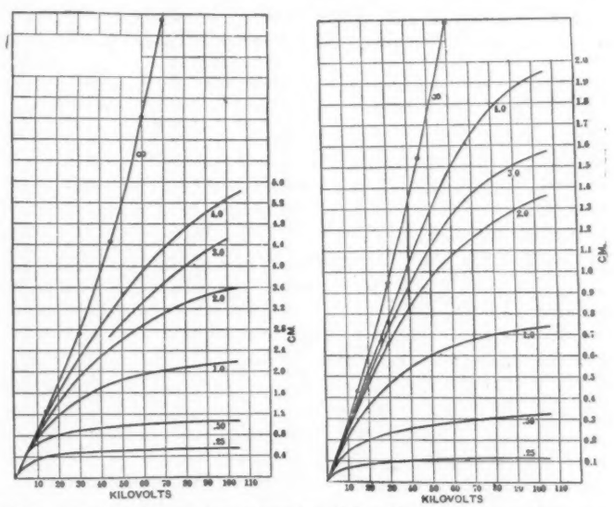
The Cook Falls development and 110,000-volt transmission line is being built by a syndicate headed by interests identified with the Commonwealth Power Company, of Jackson, Mich. Mr. J. B. Foote is electrical engineer for the undertaking. It is especially significant that under the same direction the first 60,000-volt line in this country was built, into Grand Rapids, Mich., and afterward raised to 72,000 volts, then the highest operating pressure of any system. The 110,000-volt transmission from Croton Dam to Grand Rapids, another of Mr. Foote's achievements, was also designed and put into operation almost two years before any of the present plants operating under this pressure.

A. I. E. E. PAPERS AND DISCUSSIONS

In last week's issue were printed abstracts of some of the papers read at the recent annual convention of the A. I. E. E. at Jefferson, N. H., together with summaries of the discussions. The remainder of the papers and the discussions thereon are abstracted below.

DISRUPTION STRENGTH WITH TRANSIENT VOLTAGES.

In a paper by Messrs. J. L. R. Hayden and C. P. Steinmetz, of the General Electric Company, much information was given concerning the time-lag of the disruptive discharge following the application of an electromotive force upon air and oil. This phenomenon is of industrial importance in the protection of electric circuits against over voltages of short duration, since a spark-gap of small time-lag may protect the insulation of apparatus against momentary voltages, even if set for a discharge e.m.f. higher than the voltage which the apparatus could withstand when continuously applied, if the time-lag of disruptive strength of the insulation of the apparatus is much greater than that of the protecting spark-gap. On the other hand, if the time-lag of disruptive strength of the insulation of



Figs. 1 and 2—Disruptive Strength of Needle and Sphere Air-Gaps Respectively.

the apparatus is shorter than that of the protecting spark-gap, the latter would not give effective protection against momentary voltages, even if at steadily applied voltage it discharges much below the disruptive strength of the apparatus.

The authors reported the results of tests made with needles and with 3.8-cm spheres in air and in dry white paraffine oil. For the latter, the spark-gap was arranged vertically and surrounded by a glass vessel filled with oil. For producing single high-voltage impulses of very short duration a continuous voltage was impressed upon the primary coil of a high-voltage transformer through a non-inductive resistor. During the rise of the continuous current in the transformer primary, a voltage impulse was induced in the (high-potential) secondary of the transformer. The height of the voltage impulse and its duration were determined by calculations based on the continuous voltage of the supply circuit, and the total resistance of the circuit.

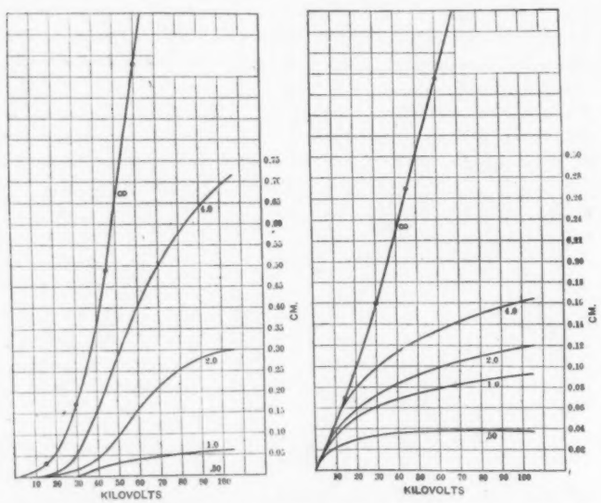
In Figs. 1 and 2 are shown the striking distances with transient voltages between needles and 3.8-cm spheres in air; each curve corresponds to a definite current input into the transformer—that is, to a definite energy value. The energy is the lower the smaller the current and the curve for unlimited energy input, as given by a steadily applied alternating voltage is marked by ∞.

It seems from this that the curves of striking distance with

transient voltages start from the curve of unlimited energy (∞) at low voltages, but drop below this curve the earlier and the more rapidly the smaller is the amount of available energy. All of the curves of constant-energy striking distance seems to approach a finite limit of striking distance at the higher voltages. With transient voltages, the striking distance seems to approach a finite limit with increasing voltage, and this limit is higher the greater is the available energy, which is behind the voltage. For sufficiently high voltage, the striking distance at limited energy becomes independent of the voltage, and is merely a function of the energy back of the voltage. Thus the usual curve of striking distance, derived by tests with unlimited energy, does not apply at all when the voltage lasts so short time that the energy back of the voltage is limited. At transient voltages of very limited energy, the striking distance is a function of the energy, but not of the voltage; it increases with increasing energy, but not with increasing voltage.

Between spheres in air, the effect of limited energy back of the voltage in decreasing the striking distance is similar to that between needle points, but is greater with low values and slightly less with higher values of energy. Thus, when a needle-gap and a sphere-gap are set to discharge at the same alternating voltage, at transient voltage the discharges would pass over the needle-gap if the energy is very small, and usually over the sphere-gap if the energy is large.

With spheres in oil, the behavior at transient voltages is similar as that with spheres in air, as seen from Figs. 3 and 4,



Figs. 3 and 4—Disruptive Strength of Needle and Sphere Oil-Gaps Respectively.

except that the decrease of striking distance with limited energy is very much greater with oil than with air, and at the lower values of energy no discharges at all could be observed—that is, the energy apparently was not sufficient to break down even the smallest oil film. This means that the "time-lag of disruptive strength" of oil is much greater than that of air, and an oil-gap requires a greater amount of energy, for puncture, than does an air-gap set for the same alternating voltage.

Although an air-gap, set for such distance as to protect oil insulation against voltages of unlimited energy, also protects against transient voltages, yet an oil-gap, even if set to discharge at an alternating voltage much lower than that which air insulation would safely withstand, would not protect against transient voltages if of sufficiently limited power.

To some extent similar relations exist between the needle-gap and sphere-gap in air. For low values of energy an air needle-gap would protect a sphere-gap against transient voltages, but not inversely; while for higher values of energy, a sphere-gap would protect a needle-gap against transient voltage, but not inversely. The differences for higher values of transient energy are relatively small compared with those for lower values, and in general, therefore, it seems that the needle-gap in air is safer than the sphere-gap in protecting against transient voltages. It follows, therefore, that spark-gap terminals are preferably corrugated or knurled.

From calculations of the energy involved, the authors concluded that an air-gap requires only 3 per cent of the energy required by the same oil-gap to start a discharge; or inversely, that it takes 33 times as much energy to disrupt oil electrostatically as it takes with air. A spark-gap between 3.8-cm spheres in air requires about five times as much energy as does a spark-gap of the same length in air between needle points.

THE ELECTRIC STRENGTH OF AIR.

Prof. J. B. Whitehead, of Johns Hopkins University, presented a paper dealing with the breakdown voltage of air as affected by temperature, moisture and the condition of the conductors. He remarked in opening that as a result of the increase in values of transmission voltage and of improvements in high-voltage apparatus and line insulators, the electric strength of air has become a limiting factor in the long distance transmission of energy.

The author described a method recently developed which permits a determination of the critical intensity or electric strength of air in the neighborhood of round wires to an accuracy within 0.5 per cent. It also permits accurate control of the temperature and moisture content of the air under observation. It makes use of the fact that electrical rupture is invariably accompanied by ionization, and that extremely minute traces of ionization may be detected by the gold-leaf electroscope, one of the most sensitive instruments known.

The wire is stretched along the axis of an outer metallic cylinder, and the voltage is applied between them. Air is drawn from the neighborhood of the wire under investigation and over a suitable discharge terminal connected to the gold-leaf system of the electroscope *G*, Fig. 1. As soon as the ionization accompanying electrical breakdown occurs the electroscope discharges.

Near each end of the outer cylinder is drilled a series of small holes permitting air to be drawn through the cylinder.

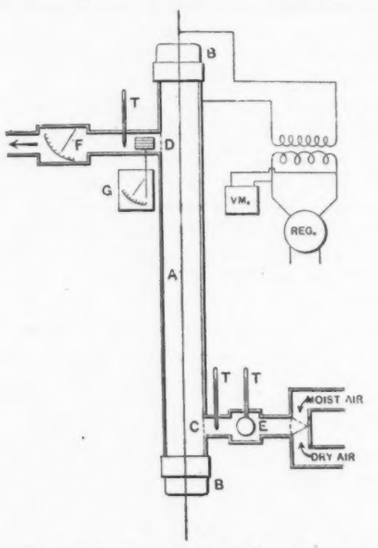


Fig. 1—Arrangement of Apparatus.

The electroscope terminal is placed close to the openings by which the air leaves. The electroscope retains its charge until the critical voltage is reached and then discharges rapidly. A diagram of the apparatus and auxiliaries is shown in Fig. 1. *A* is the wire accurately centered in the outer cylinder; it is supported under tension by dry threads well beyond the ends of the cylinder which are closed by the wood and glass caps *BB*. Air is drawn through the cylinder by an exhaust fan, entering at *C* and leaving at *D;* the velocity of the air is measured at *F*. Any degree of moisture is obtained by bubbling the air through water at various temperatures, and the driest state by drawing through a large column of calcium chloride. The

temperature of the air was controlled by passing it through a large coil of lead pipe immersed in a tank filled with ice or water of any desired temperature.

In taking observations, the electroscope was charged and a slow current of air drawn through the apparatus. With eye on the electroscope leaf the voltage was gradually raised to a value at which the electroscope just began to discharge as detected by the eye, and its rate of leak was then measured. The voltage was increased by small steps, corresponding rates of leak being taken several times for each value. The temperature and pressure were also noted. The time for discharge was found to drop from practically an infinite value to very low values (from two to four seconds) within a very small change of voltage, as shown in Fig. 2.

It was found that the point of initial breakdown was not affected by the velocity of the air through the test cylinder. Concerning the influence of the temperature, it was found that at an atmospheric pressure of 760 mm of mercury there is a drop or rise of 0.22 per cent in the critical voltage for each degree centigrade rise or fall from 21 deg. C.

The author reported observations made on copper, aluminum and steel wires of diameters between 0.089 cm and 0.5 cm centered in tubes 4.9 cm, 6.35 cm and 9.82 cm in internal diameter, and 100 cm in length. The steel wires were taken from rods of tool steel; they were perfectly straight and readily polished and handled without danger of kinks. The copper and aluminium wires were heated by electric current to dull red and at the same time subjected to tension; they were then

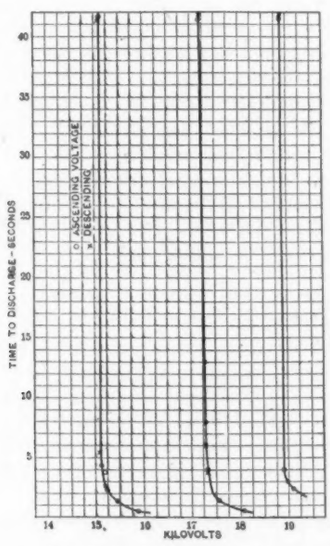


Fig 2—Typical Curves Showing Critical Voltage for Wires 0.205, 0.276 and 0.347 cm in Diameter in 6.35-cm Tube.

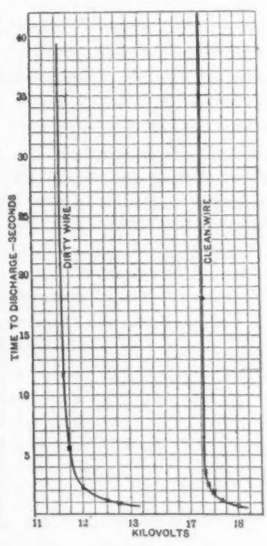


Fig. 3—Discharge Curves—Clean and Dirty Wires 0.276-cm wires in 6.35-cm Tubes.

carefully polished and placed in the outer tube without bending or contact with other objects. The two larger tubes were placed in the vertical position and the wire held under tension in accurately centered insulating bushings on the ends. The air was strained through cotton wool and a cambric screen at the entrance to the tube. On raising the voltage the charged electroscope is unaffected until the critical voltage is reached when a sharply marked rapid rate of leak sets in. Fig. 2 gives curves relating to wires 0.205 cm, 0.276 cm and 0.347 cm in diameter in a 6.35-cm tube. From these it may be seen that at the critical point an increase of 1 per cent in the voltage is sufficient to cause the electroscope to discharge in three or four seconds although it was unaffected at the lower value. With increasing values of voltage, the electroscope discharges still more rapidly, although owing to its sensibility a point is soon reached when the discharge is so rapid that its time cannot be read. The visible corona appears faintly at the beginning of the break in the curve and brightens rapidly with increasing voltage. Since the corona and power loss begin together there is no ionization before power loss sets in. The nature of the power loss has been the subject of much speculation, and the above fact is one leading to the conclusion that a part if not all of the loss is in the process of ionization—that is, the separation of the two opposite charges on the molecules of the gas. The shape of the curve beyond the critical point depends on the air velocity, distance to the electroscope, size of its terminal, etc. A further fact of interest in connection with these curves is that for decreasing voltage the curve is retraced, and ionization or breakdown ceases at the same voltage at which it began. There is thus no apparent after-effect of foregoing ionization.

Throughout the experiments on clean wires it was found that the least dust, dirt, or other inequality of surface was accompanied by a lowering of the critical voltage. On viewing such a wire through the end of a tube a discharging point could usually be detected. On raising the voltage, other points appear on a dirty wire, and the amount of lowering of critical voltage depends on the size and number of surface irregularities and their location with reference to the electroscope. Thus, for copper wire 0.122 cm in diameter taken from a fairly clean coil and not polished, the drop in critical voltage below that for clean wire was only 1 per cent. On the other hand, when a 0.277-cm polished copper wire, giving a critical surface intensity of 56,500 volts per centimeter, was heated by current until it took on a flaky coat of oxide, its critical intensity was reduced to 37,850, or by 33 per cent. Repeated observations show this point to be very constant and sharply marked. On comparing the discharge curves for clean and dirty wires (see Fig. 3), however, it will be seen that the break in the curve is less sharply marked for the dirty wire and the bend is more gradual. This indicates a lesser supply of ions, but a supply amply sufficient to cause a rapid discharge of the sensitive electroscope. It is thus apparent that the figure 37,850 has no significance, only representing the value at which the first surface irregularities begin to discharge. These discharges represent energy loss, and in sufficient quantity may cause the voltage at which appreciable loss begins to fall far below the value for clean wires.

Basing his conclusion on many experiments, the author stated that moisture in the air has no influence on the surface intensity at which ionization and loss begin. In not a single test was it possible to detect any influence of the moisture content on the critical voltage.

By means of a stroboscopic device, observations were made of the corona effect throughout each portion of a cycle. The tests showed that the corona corresponding to a given voltage will persist on the decreasing side of the wave to a value below that at which it starts on the side of rising voltage. After the intensity drops below the value at which ionization begins the foregoing plentiful ionization is able to preserve luminosity for a certain interval. This interval is extremely short and of the order of magnitude of one or two thousandths of a second. As a result of the stroboscopic tests the author expressed the belief: First, that the edge of the corona marks the limit of ionization or rupture; and second, that the corona has high conductivity, the greater part of the potential difference, and hence loss, occurring beyond its boundary. On this assumption the loss would be due to the forced passage under the electric gradient of molecular ions through the air. It is to be noted, however, that these figures do not indicate that the intensity at the edge of the corona is 40,000 volts per centimeter, the suggested constant electric strength of air, but that it is higher and its value related to the corona diameter in the same way that the critical surface intensity for a solid wire is related to the diameter of the wire.

In speculating as to the nature of the corona, the author remarked that the most conspicuous fact is that the breakdown of the air which is invariably accompanied by a more or less visible corona is attended by copious ionization. The present knowledge of ionization of gases reveals three possible sources of ions or charged particles: (*a*) the ions may be drawn from

the substance of the wire or terminal itself under the electric intensity; (*b*) the molecule of the gas may be disrupted by a separation of its two component charges by the intensity of electric field in which it finds itself; (*c*) a molecule of a gas may be ionized or separated into its component charges as a result of a collision between itself and another molecule or charged particle.

Regarding the possibility of drawing free charges from the metal of the terminals, there is the experimental evidence that the generation of ions in the neighborhood of wires is independent of the material of the wires and one should expect different figures for different materials if initial ionization started in this way. Further, it has been calculated that the electric intensity necessary to draw electrons from metal is of a very much higher value than that at which corona begins. With reference to the second possible source (*b*), it has also been shown that the intensity necessary to separate the component charges of a molecule is higher considerably than the intensity at which corona begins at atmospheric pressure.

There is considerable evidence that the third source of ionization mentioned above—that is, ionization by collision, or secondary ionization as it is called, is that which leads to the starting of corona. There are always a certain number of free electrons or negative charges and of ions of molecular size present in the air at atmospheric pressure. These free charges have their origin in the frequent collisions between molecules and are extremely few in number. A single charge does not have a long independent existence, but when it combines with a molecule of opposite charge its place is taken by other charges, so that the average condition is that of a constant number of free charged particles. These charged particles account for the conductivity of the air which may be observed by sensitive instruments.

DIELECTRIC STRENGTH OF OIL.

Mr. H. W. Tobey, of the General Electric Company, presented a paper outlining some of the more important characteristics of oil having particular reference to dielectric strength. The characteristics were exemplified by means of curves and data obtained from systematic investigations.

The dependence of the disruptive strength of oil upon the shape of the terminals between which it is tested is indicated in Fig. 1. It will be seen that the shapes of terminals which cause the lowest breakdown values are those which allow the greatest concentration of electric stress at both terminals. In other words, the terminal is surrounded by a zone of oil across which the stress is greater than in the next succeeding zone. The oil in the former is strained beyond its strength and breaks down. As soon as this occurs the stress is transferred to the next zone and this breaks, and so on across the entire gap. In actual practice, of course, these ruptures occur in such rapid succession that they are virtually simultaneous.

When the distribution of flux is perfectly uniform, as for example, between large disks placed near together, the average and maximum densities are the same. This no longer holds where the field is distorted, for in this case the stress across one section of the gap, as already indicated, may be very much greater than across the remainder. The distances between terminals may have been exactly the same, yet the second gap will break down at lower voltage because the oil in one section of it was strained beyond its breakdown point.

Concerning the effect of temperature upon the dielectric strength of oil, the author cited the case of a certain test in which a sample withstood an e.m.f. of 52,000 volts between two 0.5-in. brass disks separated by 0.2 in. when the temperature was 60 deg. C., and 45,500 volts at 20 deg. C. and 44,000 volts at zero. Upon congealing, however, as the temperature drops below the freezing point of the oil, the dielectric strength increases with great rapidity, in some cases reaching a value from 60 per cent to 80 per cent higher than that just before the freezing point was passed. In the example just referred to, the dielectric strength rose to approximately 77,000 volts, or an increase above 44,000 of 75 per cent. On heating, the strength drops to the value it had just before freezing, although it is usually necessary to raise the temperature considerably above the freezing point before this occurs. In other words, changes in strength lag behind changes in temperature. Continued heating will finally restore the dielectric strength to its initial value. The curve of Fig.

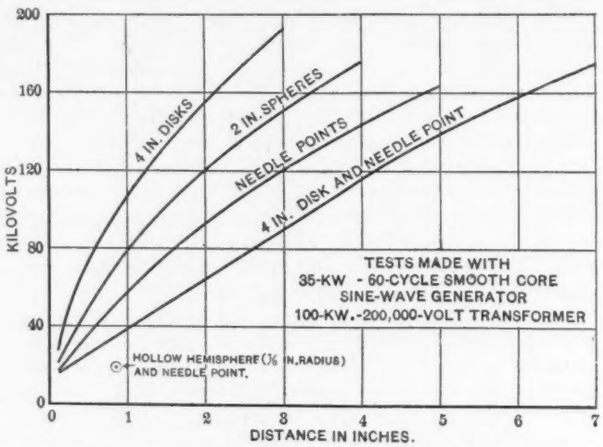


Fig. 1—Disruptive Voltage of Dry Oil Measured Between Variously Shaped Terminals.

2 indicates the cycles through which these changes take place. This may be considered typical for one kind of oil. The values for other kinds are quite likely to vary considerably from those shown by this curve, but the manner in which the changes occur are much the same.

Oil, as far as dielectric strength is concerned, is extremely sensitive to moisture, even the slightest amount being detrimental. It is, therefore, of the greatest importance not only to remove every trace before putting the oil into service, but also to maintain this condition of dryness under continued operation.

The accompanying curves, Figs. 3 and 4, emphasize these

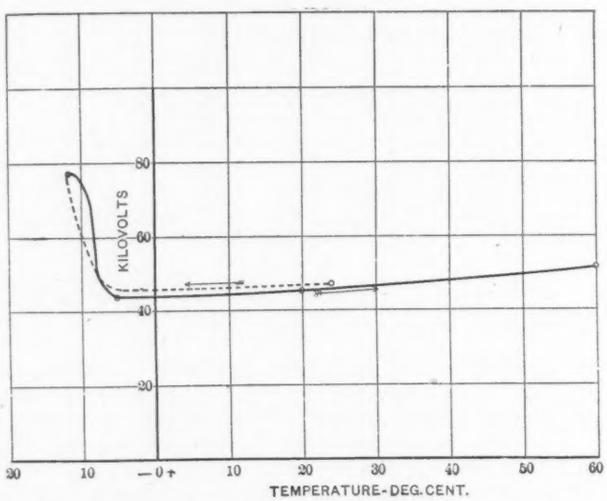


Fig. 2—Effect of Temperature on Dielectric Strength.

facts, indicating, as they do, the reduction in dielectric strength for gradually increasing percentages of moisture. The first was plotted from results of tests on a medium grade and the second from tests on a light grade oil.

It is often difficult to determine how moisture can be taken up by oil contained in apparatus having fairly tight covers, yet this frequently happens, nevertheless. Some of the moisture may settle to the bottom, where it can be gotten rid of by simply drawing off a limited quantity of oil. A certain per-

centage, on the other hand, will be retained and kept in circulation. The percentage which may be safely allowed naturally depends to some extent on the voltage of the apparatus, but that this amount must be extremely small is apparent from the curves just mentioned. Even 0.03 per cent reduces the dielectric strength to three-quarters. (This means only five or six drops of water per quart of oil.) With the addition of 0.01 per cent of moisture, the strength is reduced to one-half.

It is evident from the above that the importance of dry oil cannot be overestimated. The apparatus into which it is to be placed, including the interior surface of the tanks, should be thoroughly dried, and not only should the oil be tested for dielectric strength before it is put into service, but at stated

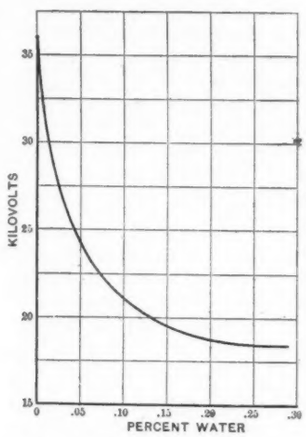


Fig. 3—Influence of Moisture on Dielectric Strength of Oil of Medium Viscosity.

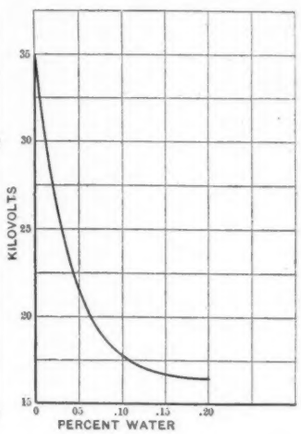


Fig. 4—Influence of Moisture on Dielectric Strength of Light Oil.

periods afterwards as well. Oil found below the desired value should be dried or replaced with new.

Of the various methods which have been used for detecting moisture, the following were mentioned by the author: A quantity of oil may be placed in a tank and allowed to settle for a week or 10 days, at the end of which time a sample may be taken from the bottom with a glass tube, or a thief. If much water is present, the eye will readily detect it. A piece of cold glass plate may be held over a sample and the latter heated to the boiling point of water. Any moisture driven off will be condensed on the plate. Anhydrous copper sulphate is sometimes used, a small quantity being shaken with the oil to be tested. If it contains moisture in any considerable quantity a slightly bluish color will result.

Still another method is to thrust a red-hot nail or piece of wire into a sample of oil. A crackling noise will be heard if moisture is present. If dry, there will simply be a puff of smoke. A similar test can be made by placing a sample of oil in a small porcelain dish, and heating it over a flame. If moisture is present a sharp, crackling noise will result, much the same as with the hot nail or wire just referred to.

Of all the methods which have been used the dielectric strength test is the most satisfactory and reliable. Moreover, it is extremely sensitive so that even the smallest percentage of moisure may be detected. This last method is the only one which can be recommended as being absolutely sure. The one mentioned just before this, that is, heating the oil in a porcelain dish, is the next most reliable, but even this is not certain. The hot-wire method would come in the same class. The other tests mentioned are only of service when large quantities of moisture are present. Otherwise, they are not reliable.

The author discussed various methods for drying and filtering oil, including the use of chemicals, heat and vacuum, heat and air, settling, centrifugal separators, and paper filters. He remarked that of the various chemicals used for dehydrating oil, calcium chloride has given the most satisfactory results, although calcium oxide (unslacked lime) is also used extensively and gives good results. Calcium carbide and metallic sodium, as well as other agents, have been tried with varying degrees of success.

When heat is used for removing moisture it is sometimes applied to the outside of the receptacle containing the oil, and in other cases is introduced by means of steam coils or an electric heater. The last-mentioned arrangement is preferable, and is usually more convenient. In all cases the temperature maintained is about 105 deg., or, in other words, slightly above the boiling point of water. This process at best is slow. It must be watched with great care, and there is always the danger of injuring the oil from overheating. Long-continued overheating will cause a deposit to be thrown down and is also liable to change the nature of the oil by driving off some of the lighter hydrocarbons. The danger of the overheating may be practically overcome by removing the air pressure from the drying receptacle and employing heat as before. The reason for this is that water boils at much lower temperature at vacuum pressure than at ordinary air pressure.

Air rendered perfectly dry by passing it through calcium chloride or other drying agents can advantageously be forced through numerous openings at the bottom of the tank and allowed to bubble up to the surface. The oil in the tank may or may not be heated, although heating naturally facilitates the operation.

The water in oil may be gotten rid of almost entirely by allowing it to stand for some time undisturbed. The water, as well as some of the impurities, gradually settle to the bottom, leaving a dry oil to be drawn off from the top. The process usually requires a number of days and herein lies the greatest difficulty in its use.

The different specific gravities of oil and water make it possible to separate the two by centrifugal action. It is extremely difficult to remove all of the moisture by this means, but it serves a good purpose in taking out a considerable portion of the water when the oil is extremely damp. The remainder, however, may be removed by means of a filter within the upper part of the machine, so that virtually both steps in the process take place at the same time. The operation may be accomplished by a standard cream separator.

A method for removing moisture from oil which has recently been introduced on a large scale consists in passing the oil through ordinary filter paper, which will not allow water to pass. The apparatus employed consists of a press for holding the paper, a pressure pump and an operating motor, together with necessary piping, valves, gages, etc. The most interesting part of the outfit is made up of a number of alternate grids and chambers arranged in such a way that square sheets of blotting paper may be placed between them and the entire device bolted together. By means of suitable channels the oil from the pressure pump is led into the chambers, forced through the blotting paper and finally discharged into the receiving tank. The blotting paper allows the oil to pass, but retains all moisture and impurities, thus raising the dielectric strength to values as high as 60,000 volts to 70,000 volts (measured between 0.5-in. disks placed 0.2 in. apart). With a moderate-sized press 600 gal. of medium grade oil may be treated per hour, and twice this amount of light oil, it merely being necessary to replace the blotting paper occasionally, once every half-hour to an hour is sufficient with oil in fair condition.

The oils now most commonly used for insulating purposes are obtained from crude petroleum by "fractional" distillation this being entirely distinct from the method known as "cracking" distillation, used for obtaining the greatest yield for burning oils. Fractional distillation is carried on in such a way as to yield a sweet, unburned residual oil, while distillates of higher boiling points, after being subjected to various other manipulations, become what may be called insulating oils. The process is carried on in such a manner as to preserve the hydrocarbons in their natural form. The characteristics, such as flashing and burning points, viscosity, etc., depend, of course, upon the limits worked to during the process of distillation and

refining. The data in the accompanying table indicate what may be expected from a medium and from a light grade oil:

	Medium	Light
Flashing temperature	180 to 190 deg. C.	130 to 140 deg. C.
Burning temperature	205 to 215	140 to 150
Cold test	−10 to −15	−15 to −20
Specific gravity at 13.5 deg. Cent	0.865 to 0.870	0.845 to 0.850
Viscosity at 40 deg. Cent (Saybolt test)	100 to 110 sec.	40 to 50 sec.
Acid, alkali, sulphur, moisture	None	None

When free from moisture both have the same dielectric strength (45,000 volts to 50,000 volts, sine wave, between 0.5-in. disks placed 0.2 in apart). The two most noticeable differences are in the fire and viscosity tests. The medium grade has a flashing temperature about 50 deg. above that of the lighter oil and a burning temperature about 60 deg. above. As to viscosity, a given quantity of the medium-grade oil requires about 2.5 times as long to pass through a given orifice as does the light grade, conditions as to temperature, etc., of course, being the same.

It is usually customary for reasons of design to use the medium grade in apparatus, such as self-cooled transformers, in which the temperature of the oil at the top, due to overloads, etc., may reach fairly high values, the lighter grade being employed in apparatus, such as water-cooled transformers, where the temperature may be more readily controlled.

DISCUSSION.

The papers by Messrs. Hayden, Steinmetz, Whitehead and Tobey were presented in succession and discussed together. The discussion was opened by Mr. D. B. Rushmore, who remarked that the limit in transmission e.m.f. around 60,000 volts previously set by the line insulator has been removed by the substitution of the suspension type for the pin-type insulator. At the present time the limit is set by the dielectric strength of the air between the line conductors or the corona loss around the conductors at high voltages. The voltage may be increased without exceeding a specified loss by enlarging the conductors, but there is a limit beyond which the conductors cannot be enlarged. In any event it is of importance to study the laws relating to the formation of corona and the bearing of the surroundings on the loss occasioned by the corona.

Prof. V. Karapetoff, of Cornell University, discussed the analogue to electric stress in dielectrics as found in the mechanical stress in materials and expressed his surprise at the results indicated by the investigation of Mr. Hayden and Dr. Steinmetz, which are contrary to what one would expect from the mechanical analogue. He questioned the accuracy of the estimation made by the authors relative to the e.m.f. applied because the inductance of the testing circuits and the condenser storage effect of the air dielectric had been neglected.

Dr. A. E. Kennelly expressed the opinion that certain of the results obtained by Professor Whitehead on wires of small diameter can be accounted for by assuming a compression of air in the immediate neighborhood of the wire. Such a compression could be attributed to the unequal attraction and repulsion of polarized particles of air in the alternating electrostatic field of non-uniform density surrounding the wire, the non-uniformity being relatively greater with the smaller wires.

Mr. W. H. Pratt said that one should not assume that specially prepared air, such as that used by Professor Whitehead, possesses the same electrical properties as external air such as surrounded the lines tested by Mr. Mershon at Niagara Falls in 1907. Possibly the difference in conductivity of the air in the two cases accounts for the seeming discrepancy in the results reported by Professor Whitehead and Mr. Mershon.

Prof. E. E. F. Creighton, of Schenectady, reported observations with alternating voltage and unidirectional voltage which showed conclusive evidence of a time lag in the electric disruption of air. For example, a steadily applied direct voltage is able to arc across a spark-gap which is not broken down by an alternating voltage of much greater maximum value, the conclusion being that the maximum value is applied for too short a time in each cycle to cause disruption. Tests show that the time-lag when plotted along the x axis with the disruptive voltage along the y axis traces a hyperbole having the equation $x(y-23)=1780$, the y values being in kilovolts and the x values in milliseconds. In regard to the effect of "dirt" in lowering the discharge e.m.f., it is noteworthy that the effect cannot be attributed solely to the roughening of the surface. When the disruptive voltage between two terminals has been decreased by the formation of a coat of oxide on the terminals it may be restored to almost its former value by chemically removing the oxide without altering the degree of roughness of the surfaces.

Mr. C. F. Scott, of Pittsburgh, remarked that the lack of agreement between the results obtained by Professor Whitehead and Mr. Mershon, respectively, points to the necessity of checking the results obtained from laboratory tests before assuming them as being directly applicable in practice. Laboratory tests allow one to determine the laws relating to interconnected phenomena, but the constants must be ascertained under actual operating conditions.

Mr. R. D. Mershon, of New York, outlined the conditions under which the Niagara tests were conducted and expressed the conviction that the results reported were accurate within 10 per cent, the consistency of observations made at various times throughout more than one year was such as to preclude the possibility of inaccuracy in observation as to the effect of moisture upon the atmospheric loss between wires. He questioned the accuracy of the methods used by Messrs. Hayden and Steinmetz in determining both the energy of the discharge and the e.m.f. at discharge.

Dr. Steinmetz explained that the energy values given in the paper relate to the primary circuit of the testing transformer and are greater than the values actually reaching the dielectric. They represent the amounts of energy which will surely break down the dielectric, being somewhat beyond the upper limit in this respect. He claimed that the features of inductance and capacity neglected by him in calculating the e.m.f. are of no great importance and can safely be ignored. He expressed the belief that a thin layer of highly compressed air surrounds a conductor and this must be punctured before break-down occurs. As the voltage is raised a layer of corona forms around the wire, thereby increasing the size of the conductor and altering the electrostatic capacity of the circuit. The corona may be in contact with the wire or may be separated therefrom by an extremely thin layer of compressed air. It is not correct to assume that ionization, the formation of visible corona, the production of measurable loss, etc., occur at the same voltage; it is more than probable that these changes represent definite stages through which the dielectric passes as the e.m.f. is slowly increased in value.

In reply to questions by Messrs. J. C. Lincoln and P. H. Thomas, Professor Whitehead said that so far as he was able to determine the positive and the negative ions were present in equal quantities, there being no evidence of preponderance of one over the other. The test tube was provided with insulating end-caps made of wood and glass, which effectively shielded the inside of the tube from any ions that might have been formed at the abrupt end of the tube. He called attention to the fact that the investigations made by Messrs. Hayden and Seinmetz were not so conducted as to provide conclusive evidence of any time-lag in the disruptive discharge.

In reply to a question by Mr. R. D. Mershon, Mr. Tobey said that the freezing point of transformer oil is at about −10 deg. C. Below this temperature the oil congeals to a density about equal to that of vaseline at ordinary temperature, and its dielectric strength is even greater than when at higher temperatures, so that nothing is to be feared from the freezing of the oil in transformers.

ROTATIVE ENERGY OF INDUCTION MOTORS.

In a paper entitled "Interactions of Flywheels and Motors when Driving Roll Trains by Induction Motors," Mr. F. G. Gasche gave a mathematical analysis of the energy stored in and the power consumed by induction motors in rolling-mill

service. He attributed to the use of energy-storing flywheels with the induction motor the following advantageous characteristics: (*a*) Providing reservoirs of energy exterior to the power plant in excess of the structural and commercial possibilities of flywheels on the prime movers, or of storage batteries; (*b*) equipment of the roll trains with an independent means of freeing the rolls of the bars, in case the motor becomes suddenly inoperative; (*c*) raising the load-factor on the power plant; (*d*) reduction of size and costs of installation of motors, particularly with variable roll-train loads.

DISCUSSION.

Dr. C. P. Steinmetz remarked that the mechanical problems involved in the supply of energy to roll-trains are similar to the electrical problems in transmission circuits where transient phenomena are encountered. In fact, many of the solutions in the one case are applicable by analogy in the other case.

Mr. C. F. Scott stated that the substitution of the electric motor for steam engines in rolling mills has revolutionized the design of such mills and the methods employed in their operation. Moreover, the use of flywheels with electric motors has enabled rolling mills, which represent the most violently fluctuating loads, to be equipped with gas engines as prime movers, although these engines are of all types of prime movers least adapted to fluctuating loads.

Mr. Gano S. Dunn expressed the opinion that the highest equipment efficiency and the most satisfactory service can be obtained by using very heavy flywheels with low-slip motors rather than lighter flywheels with motors giving a larger range in speed. In either case the flywheel will store and return the desired amount of energy in each operating cycle, but the low-slip motor is more efficient and requires less generating equipment than does the machine of higher slip.

VOLTAGE REGULATION OF TRANSFORMERS.

In a paper by Prof. Adolph Shane, of the Iowa State College, a description was given of a method for directly measuring with considerable accuracy the voltage regulation of a stationary transformer. The method involves the use of two similar transformers, one operated at full load and the other at no load, and a third transformer for assisting in determining the difference in the voltages on the secondary circuits of the other two transformers. The primaries of the three transformers are joined in parallel and the secondaries of the two similar transformers are joined in open parallel, so that the resultant e.m.f. between the free leads is the true impedance voltage of the loaded transformer. The secondary of the third transformer is joined in series opposition with the secondary of the unloaded transformer and the number of its secondary turns is varied until the resultant e.m.f. across the three secondary circuits is a minimum as shown by a galvanometer. Under these conditions the secondary e.m.f. of the third, variable voltage transformer is the regulation voltage of the loaded transformer.

The author described also a method for calculating the regulation on the basis of the data obtained from the secondary e.m.fs. and currents of two similar transformers, one being operated at no load and the other at full load. A voltmeter connected across the free leads of the secondary circuits joined in open parallel shows the true impedance voltage of the loaded transformer, as noted above. The resistance component of this impedance is found by means of a wattmeter, the shunt coil of which is subjected to the impedance e.m.f. and the series coil of which carries the secondary current. The calculations of the regulation are based on the resistance and impedance values in the usual manner. Test data given by the author indicate that the two methods outlined above give results that are thoroughly consistent, although differing from results obtained by the familiar short-circuit testing method.

DISCUSSION.

Mr. E. A. Wagner and Mr. L. T. Robinson questioned the accuracy of the results obtainable with the methods described by Professor Shane, while a written communication from Mr. Fortescue also expressed doubt as to the accuracy. Professor Shane showed that under those conditions which might be assumed as causing the greatest error, the instruments are most sensitive and inaccuracies are least likely to appear in the observations.

VECTOR REPRESENTATIONS IN ALTERNATING-CURRENT PROBLEMS.

Dr. A. E. Kennelly, of Harvard University, presented a paper indicating the limitations under which power in an alternating-current circuit may be treated as a stationary vector; extending the technology of vector alternating-current quantities; combatting the use of the terms "wattless power" and "wattless current" by offering more logical terms as substitutes, and presenting a plea for the standardization of phase rotation in the vectors used in alternating-current theory.

After explaining the different methods that may be employed for representing alternating-current quantities by means of vectors, the author designates as "direct representation" that method which, in the direction of positive rotation, makes a leading current lead and a lagging current lag with respect to its e.m.f., while the opposite method he defined as "inverse representation." In a list of standard publications 42 use the direct representation and 24 the inverse representation.

In discussing the quantity sometimes called the "wattless power," the author said that the direct product of the current by the e.m.f. is commonly called volt-amperes. He claimed that although it may be practically advantageous to call the unit of apparent power the volt-ampere in order to distinguish apparent power from effective power in engineering, yet a volt-ampere is essentially a watt, and the apparent power is correctly stated as apparent or resultant watts, the vector sum of effective and reactive watts. The effective component is the average power delivered to the circuit by the generator, and is usually called the "real power." The reactive power is however, when considered from within the circuit, just as the effective power so that the term "real power" is unsuitable. The reactive power is the maximum cyclic power expended in transmitting energy into and out of the magnetic flux linked with the circuit, being alternately plus and minus, or from and to the generator, in successive quarter cycles of current. This energy is kept in the circuit; whereas the effective power transmits energy out of the circuit. The maximum reactive cyclic power is all internal. The effective power is the average of that delivered externally, is the cyclic average of the instantaneous total internal power, and is also the maximum cyclic value of the externally delivered power.

The author showed that it is readily possible to compute and discuss the power in an alternating-current circuit as a stationary-vector quantity, without reference to the double-frequency or rotative-vector power. He showed also that the energy in a single-frequency alternating-current circuit follows the projection, upon the rail, of a flange-point on a wheel rolling along the rail with uniform angular velocity. The path of the flange-point is an oblate trochoid for reactive circuits, but is a cycloid for a non-reactive circuit. He said that in any alternating-current circuit, or portion of the same, there are four non-rotating vectors, *Z, E, P, W* to standard current phase, and also four *Y, I, P, W*, to standard potential-difference phase, all connected by ordinary vector arithmetic, and not involving double-frequency products. He concluded that the algebra of alternating currents may be regarded as the same as the algebra of continuous currents for power as well as for other quantities, so that any formula relating to direct-current circuits is also a formula relating to single-frequency alternating-current circuits, when complex numbers are substituted for real numbers.

DISCUSSION.

The discussion of Dr. Kennelly's paper assumed the form of the presentation of arguments for and against the author's so-called direct representations, Prof. D. C. Jackson and Mr. W. W. Crawford siding with the author and Dr. C. P. Steinmetz, Mr. J. B. Taylor and Mr. L. T. Robinson taking the opposite view. At the suggestion of Mr. Gano S. Dunn it was voted to

refer the matter for consideration to the International Electrotechnical Commission through the channels of the American committee of that commission.

ALTERNATING-CURRENT MEASUREMENTS.

In a paper entitled "Some Recent Developments in Exact Alternating-Current Measurements," Dr. C. H. Sharp and Mr. William W. Crawford, of the Electrical Testing Laboratories, described certain new methods and apparatus which have been designed for rendering alternating-current measurements as accurate as direct-current measurements.

The authors remarked that in precise direct-current work zero methods are used to the exclusion of all others, but in alternating-current measurements zero methods have not been used to so great an extent, largely because of the lack of proper facilities for applying them when using currents of commercial frequencies. The difficulty of applying zero methods to alternating currents lie chiefly in the instrument used as a detector in obtaining a balance. By rectifying the alternating current and passing the rectified current through a direct-current galvanometer used as a zero detector excellent results have recently been obtained. The apparatus developed for this purpose places alternating-current measurements on the same basis as direct-current measurements with respect to the sensibility of the galvanometer. Using the galvanometer as a deflection instrument, such quantities as the drop in a short length of iron rail or in a bond carrying alternating current, the measurement of the leakage and charging current of a few insulators, or of a short length of cable, etc., may be easily measured. The mechanical imperfections of the rectifiers thus far constructed are such that the calibration as a deflection instrument is not accurate, due to the reversal not taking place exactly at the zero of the wave, but when the calibration is made under the conditions of use it will be sufficiently accurate for the class of measurements involved.

The authors described a method of determining the current ratio in a transformer by introducing resistors of low resistances in the primary and secondary circuits and balancing the drops against each other by means of a zero detector, has been tried by various experimenters. The ratio of transformation is the inverse ratio of the resistances. Due to the slight phase difference between the two currents there will remain, when the drops are adjusted to equality, a slight voltage, practically 90 deg. in time-phase from the resistance drops. The effect of this voltage is eliminated by introducing a proper "mutual inductance," which adds to the drop in one resistance a small voltage in time-quadrature with it, thus balancing the phase displacement. Tests have shown that the transformation ratio can be determined within 0.1 per cent and the angle of time-phase displacement within a few minutes.

The paper contained descriptions of the resistors and mutual inductors used in measuring transformation ratios. In the mutual inductor use is made of four coils so arranged that the effect of stray fields is small. The coefficient of mutual inductance of the coils is variable at will by changing the overlap of the several coils.

A description is also given of heavy-current resistors to be used as non-inductive shunts for current-measuring instruments. The terminals of the resistor consists of two heavy copper blocks which lie horizontally on the top of the containing case. A series of bars are silver soldered to the terminal blocks, alternate bars being attached to the positive and negative terminals, respectively. These bars extend directly downward into an oil bath. Each sheet of resistance metal is folded double and its ends attached to two adjacent bars of opposite polarity. By this arrangement each sheet is made non-inductive and any desired number of sheets may be connected in parallel. The resistors are immersed in oil and cooled by a water jacket.

DISCUSSION.

Prof. V. Karapetoff, of Cornell University, outlined the various types of instruments developed for measuring alternating-current quantities and stated that two types are well suited for precision work, namely, the hot wire and the thermo-elecric, both of which can be directly calibrated with direct current and are equally as accurate when measuring alternating as direct current.

Mr. L. T. Robinson, of the General Electric Company, claimed that an electro-dynamometer arranged for use with a separately excited field is equally as accurate for use with alternating current as are the constant-field direct-current instruments of precision.

Mr. W. H. Pratt, of the General Electric Company, called attention to the fact that a very satisfactory non-inductive shunt resistor for measuring heavy alternating currents can be made of a pipe with which the water flowing therein is used as a cooling medium. A non-inductive resistor free from eddy-current effects can be made up of a copper cable in which each strand is individually insulated by a braiding.

Dr. C. P. Steinmetz showed that by means of two constantly excited mercury-arc rectifiers one can obtain direct current from an alternating-current source for use in delicate testing instruments.

Central Station

Management, Policies and Commercial Methods

ELECTRIC VEHICLE PROMOTION AT DENVER, COL.

During the St. Louis N. E. L. A. convention, Mr. Frank W. Frueauaff, general manager of the Denver Gas & Electric Company, decided that it might be advisable and profitable for that company to inaugurate in connection with its commercial work a new department for promoting the sale of electric vehicles and trucks in Denver. Dr. M. Ekstromer, of Cambridge, Mass., was employed and is now in Denver actively promoting this work. The company does not intend to handle electric vehicles. Dr. Ekstromer's work will be to advise and assist automobile dealers, garage owners, and possible purchasers and users. He is at the present time visiting all the automobile dealers and garage owners, tendering his services to them in an endeavor to assist their salesmen in selling electric vehicles, and doing all in his power to help consummate sales. He is also following up the Denver Gas & Electric Company's many consumers who have electric vehicles and who own private garages, offering them assistance whenever they are in need of technical aid. After this department had been in operation for a month, the company found a large need for the work undertaken, and Mr. C. N. Stannard, secretary and commercial manager, believes from present indications that it has inaugurated a very profitable department. Dr. Ekstromer's arrival in the city was duly heralded with a portrait and interview in one of the Denver papers. In this interview Dr. Ekstromer states that he knows of a large dry goods house in Denver whose deliveries last year cost $48,000. This house will replace its present method of transportation with electrically operated vehicles, which means 30 per cent cut in this portion of its expenditures.

The Denver Gas & Electric Company is also seriously considering the organization of a refrigeration department to to work along similar lines.

A "PROSPECT" BOOK FOR THE CONTRACTORS.

Enterprising electrical contractors are frequently the central-station's company's best solicitors. Through the energies and

efforts of these constructive men, the electric company frequently obtains much valuable business. The company can in part reciprocate these favors, earning the co-operation of the contractors, as one wide-awake central-station in the Middle West does, by maintaining in its office a "prospect" book containing the name and address and character of job proposed of every probable customer or inquirer who calls at the company's office to discuss electric service. This book is kept open to all the contractors, and the information it contains is common property. A contractor's impetus frequently assists in hastening a slow connection, and the scheme is especially valuable to the electric company in getting the contractors to visit its office at frequent intervals and keep in touch with its efforts to install electric service.

RE-POWERING MACHINE TOOLS.

One of the greatest advantages of the electric drive is the facility with which the power requirements of different tools and machine combinations can be tested from time to time for the purpose of securing the most positive and efficient operation of the plant. By means of a few electrical measurements data may readily be secured to determine the power necessary to operate the machine. In the following paragraphs are given the results of a number of tests of this kind in a large foundry, with the changes determined by simple voltmeter and ammeter readings. The data illustrates the need of going over machine-tool installations from time to time to find out whether the conditions of power supply and utilization require a readjustment of the motors in relation to the tools, a substitution of group for individual driving, or vice versa.

All motors in service were of the direct-current type, wound for 500 volts, and were replaced by 550-volt, three-phase motors.

One 30-hp motor, running at 650 r.p.m., driving a line shaft and three rattlers, light took 2.2 kw; driving one rattler loaded it took 3.5 kw. The motor was replaced by a 7.5-hp motor running at 1200 r.p.m.

One 7-hp motor, running at 950 r.p.m., driving a suction fan for rattlers, with usual load, took 2.86 kw. The motor was replaced by a 5-hp motor running at 1800 r.p.m.

One 3-hp motor, rated speed 1700 r.p.m., driving a sand conveyor when running unloaded took 0.9 kw. A 3-hp, alternating-current motor, running at 1800 r.p.m., was substituted for this motor.

One 2.5-hp motor, rated speed 1620 r.p.m., driving a double grinder, with grinder idle took 0.68 kw, with the motor driving grinders, two men grinding light castings, it took from 1.1 kw to 1.8 kw. A 2-hp, 1800-r.p.m. motor was substituted.

One 2-hp motor, running at 1280 r.p.m., driving a 36-in. exhaust fan, removing gases from the core room and ovens, with normal load, took 1.8 kw. It was replaced by a 3-hp motor running at 1800 r.p.m.

One 5-hp, 1200-r.p.m. motor, driving a sand mixer, when running light took 0.92 kw; and when running loaded it took 1.84 kw. This motor was replaced by a 4-hp, 1200-r.p.m., alternating-current motor.

One 2.5-hp, 1700-r.p.m. motor, driving a rattler, when running light took 2.2 kw. A 3-hp, 1800-r.p.m. motor was substituted for this motor.

One 40-hp, six-pole motor, rated at 975 r.p.m. light and 840 r.p.m. loaded, driving a Root blower, one hour after starting took .26 kw. A 35-hp, 900-r.p.m. motor was substituted for this motor.

One 2.5, 1800-r.p.m. motor, driving a 36-in. band-saw, a 14-in. bench-saw and a 7-in. lathe showed the following conditions: Motor driving shaft light took 0.66 kw; motor driving band-saw, 2-in. pine stock, took 1.1 kw; motor driving band-saw, with 2-in. plank on bench saw, took 3.3 kw. This load was so excessive that motor speed was reduced to 70 per cent of normal speed. The motor was replaced by a 5-hp, 1800-r.p.m. motor.

One 2-hp, 2000-r.p.m. motor was connected to a 3-in. x 24-in. planer. This motor was unable to plane wide stock at desired speed. It was replaced by a 5-hp, 1800-r.p.m. motor.

A SILENT FLATIRON CAMPAIGN.

By William H. Stuart.

A silent flatiron campaign has recently been started in Jersey City, N. J., and has so far proven much more of a success than any other method heretofore used. Jersey City for a city of its size has always been a peculiar field of central-station endeavor and is not as a rule responsive to the general run of selling campaigns, no matter what the article or product may be.

About a month ago the Public Service Corporation launched what they call a "silent" flatiron campaign, and of every 100 irons put out, but four or five were returned. The method of conducting the campaign was very simple. A list of residential consumers was compiled from the consumers' ledgers and carefully gone over so as to get a list that would prove as fertile for the sale of irons as possible. To each name on this list there was sent a flatiron in a sealed package, prepaid, by express. In the package a letter was enclosed which stated briefly the fact that the iron was sent out for approval and use and that an employee of the company would call and demonstrate the iron in a day or so. As full and complete directions as to the actual use of the iron were enclosed in the package, the call of the demonstrator was more to learn from a personal interview the exact feeling toward the iron than to demonstrate; yet a demonstration was given in every case and a number of "wrinkles" displayed that easily proved the iron's worth over the old-style flatiron. If there was any doubt as to whether the iron was to be purchased or not expressed by the consumer, the iron was left for a free trial for a period of 30 days, at the end of which time it was to be returned or charged to the consumer. As has been stated above but a very small percentage of the irons were returned, and this method has certainly proved a success in this territory.

An official of the company in speaking of this campaign said: "The main idea of this campaign in sending the flatiron in a sealed package prepaid by express was to get the iron in the house. We have our doubts as to whether a demonstrator going from one consumer to another with an iron in hand would gain admittance and be granted an interview in many houses; then, again, a demonstration given in our showrooms would be a big gamble in so far as the actual sale of irons was concerned. In this case we succeeded in actually getting the iron in the house and also in attracting to it particular attention. The way was paved for the demonstrator and in a great measure half the work was accomplished and the sale practically closed. Of course there were a few things about the iron that the demonstrator showed which helped to establish the iron in the good graces of the household. We think from the results obtained so far that this scheme has been a big success in Jersey City, and the fact that but four or five irons out of every 100 were returned proves so. We may in the future attempt to put in operation a similar scheme to secure the sale of other appliances and we expect in a great measure something like the success obtained with the irons."

Wiring and Illumination

HOUSE WIRING AT $2 PER ROOM.

The average non-consumer of electricity needs to have his mind disabused of the notion that electric wiring or electric service is so outrageously expensive as to be the luxury of the rich rather than a necessity and convenience for all classes. Perhaps he has gotten into his head some vague notion from somewhere that the electric wiring for any ordinary house, even of the simplest construction, costs $100 or more. With this uncomfortable idea firmly fixed, he is, of course, an unresponsive subject to the emulation of his neighbors who use electricity.

The best way to correct the impressions of those good folk who are yet too conservative to use electricity or install service

is by showing them some simple concrete figure, so low as to be impressive, which they can apply to the case of their own houses.

The Marion Light & Heating Company, of Marion, Ind., after securing the co-operation of local contractors, recently blazoned forth in signs and advertisement the good news that during June only any contractor in Marion would wire any house, at $2 per room, furnishing cord drop and socket in each.

Seventy per cent of the houses are already wired in this middle-aged Indiana town of 20,000, but the proposal had the effect of stampeding those balancing on the fence, and more than 40 new houses were wired this month compared with any preceding period.

RESIDENCE LIGHTING.

In a paper read by Mr. H. J. Gille before the St. Louis convention of the National Electric Light Association it was stated that the development of residence lighting presents many interesting problems that are materially different from those of commercial lighting. Convenience and economy depend largely upon the proper location of switches. It is, therefore, important that the wiring be properly laid out before the work is done. The outlets, the style of fixture, the kind and size of lamps are all more or less controlled by decorations and furnishings. In the past, when combustible illuminants were used, it was necessary to place these far enough from the ceiling to avoid danger from fire and damage to decorations. This has been entirely changed through the introduction of electric lamps, especially since the introduction of high-efficiency units and artistic fixtures for their use.

It should be recognized that there are many considerations outside of the immediate field are factors in residence installation. Interior decoration should be the consistent relationship between light, color, form, proportion and dimension. In music it is an established fact that certain notes used in pleasing combination produce sounds called harmony; unless the right notes are struck our sensibilities are jarred. In the use of light and color the same immutable law applies. No more delightful harmony of color can be imagined than that provided by nature; it starts in with the brown of the earth and runs into several shades of green, and from that touches upon yellow and from yellow to orange, from orange to red, and red to violet, and from violet to the blue of the sky. Learned scientific men have put forth remarkable statements concerning the physiological influence of color. An eminent London physician spoke highly of the beneficial effect upon the nerves and the eye of soft-toned greens; vivid yellow produces exhilaration and confidence; violet tones have a tendency to depress; softened or broken white is quieting to the brain of the busy man; quiet tones in the sleeping-room are soothing and delightful. The effect upon the brain where a color treatment has been carried out not consonant with the personality of the occupant is more serious than is generally realized, as it extends to the entire system. The constant dropping of water wearing a stone illustrates this action of color upon the nerves of the brain. The constant presence of irritating color is so real as to produce physical distress, and medical aid is often called in when what is really needed is a change of wall paper.

In many houses the walls are left white for a year or more until the new plaster settles. In this condition a small unit of light is sufficient; but when the decorator completes his work, adding fabrics and wall-paper which absorb and diminish the light, the consumer does not always comprehend why his lighting bills increase, being unaware that the cause is his taste for dark-colored furnishings. These facts must be understood to be remedied, and it remains for the illuminating engineer to learn by experiment the value of light as it affects or influences color, as well as the value of color as it affects light, in order to determine the amount of light required to produce the best results.

The development of residence lighting, therefore, depends not on the economic question only, but upon the character of the light, its color influence and the structural character of its introduction. Any plan to develop residence lighting must include the co-operation of architect, contractor, fixture dealer and decorator. They are important agents in the proper installation and arrangement of the electrical equipment, and are in a position to assist materially in bringing to the attention of the public the value of electric service in the home.

The public uses electric service, not from compulsion, but from choice. The desire for it may in a general way exist, but through some misunderstanding, fear of danger, high cost of energy, cost of installation, lack of information regarding proper methods of wiring or use of the energy, or numerous other reasons, the choice may be delayed. It is, therefore, necessary to prosecute a vigorous campaign of well-planned publicity in addition to energetic and enthusiastic personal solicitation to correct erroneous impressions and properly place the true merit of electric lighting service before the public.

HOME-MADE CHANDELIER HOOK AND LOOPS.

By E. B. Watson.

Chandelier loops and hooks are often used in connection with conduit wiring installations. Examples of their application are shown in Figs. 1 and 2. Fig. 1 represents an arc lamp

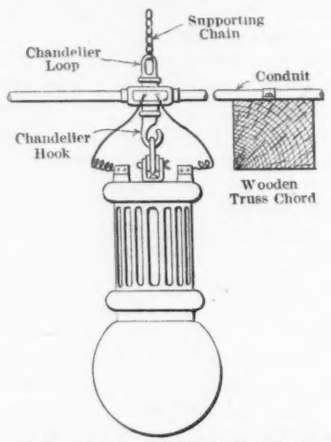


Fig. 1—Chandelier Loop and Hook Supporting Arc Lamp

suspended at the middle of a bay, in a building of wooden mill construction, by a chandelier loop and hook. From the loop a chain is carried to the roof above and secured in a screw-eye turning into the roof timbers. Through this arrangement the stress, due to the weight of the lamp, is taken

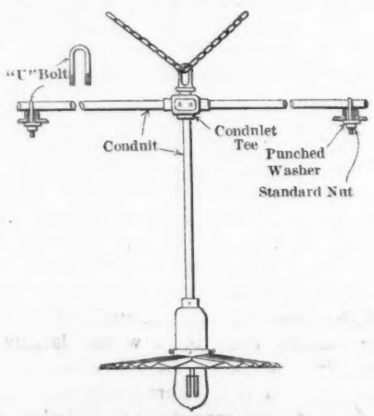


Fig. 2—Tungsten Fixture Supported by Chandelier Loop.

almost wholly by the chain and there is practically no tendency for the conduit to break, in the threads, where it turns into the condulet tee. If a chain or some auxiliary support is not used ½-in. conduit will not support, without excessive deflection, an arc lamp at the center of a 20-ft. bay. The lamp hangs on a chandelier hook turned into the bottom outlet of the condulet.

Fig. 2 illustrates a method, often utilized, for supporting a

tungsten lamp fixture at some point between trusses. The example is taken from an installation in a steel factory building. The main conduit is clamped, with U-bolts, against the upper edges of the two angles forming the bottom chords of the roof trusses. Two chains are necessary here. Each chain is made fast, at its upper end, to one of the truss members near the roof. It would not be practicable to use only one vertical chain, because the roof is a concrete slab to which attachment would be difficult. It is cheaper and better to use two chains than to drill and plug the concrete roof in order to effect an attachment.

In both of the cases cited (Figs. 1 and 2) the chandelier loop is of the ordinary commercial pattern, which can usually be obtained at any plumbing or electrical supply house. It will be usually cheaper to buy chandelier loops and hooks ready made than to make them. If it is not practicable to buy them, or if some are needed immediately and there is not enough time to send to the dealer, they may be made as suggested in Figs. 3 and 4.

In the method shown in Fig. 3 an ordinary commercial pipe-cap is drilled and tapped, and a piece of wrought-iron rod, say

Fig. 3—Chandelier Loop Made from Pipe Cap.

Fig. 4—Chandelier Loop Made From Pipe Plug.

of a diameter of ¼ in., is threaded on one end and has a ring formed at its other end. Whether the ring is left open or closed depends on whether the resulting appliance is to be a loop or a hook. The threaded end of the loop or hook is turned into the hole tapped in the cap and the device is complete. To prevent any possibility of the loop turning out of the hole it is a good plan to "bead-over" its end on the inside of the pipe cap. The wrought-iron rod shown in Fig. 3 is so bent as to form a hook rather than a loop.

A "home-made" loop is illustrated in Fig. 4. In this, a pipe plug, a readily obtainable fitting, is drilled and tapped to receive the threaded end of the loop. The construction outlined in Fig. 3 is neater than that of Fig. 4, but usually either is installed where it cannot be seen, so appearance is of little consequence. The plug-loop (Fig. 4) can be turned directly into a condulet fitting while an additional nipple is required where the cap-loop (Fig. 3) is used. Because of this the plug construction is usually preferred.

NEW TELEPHONE PATENTS.

TRANSMISSION CIRCUIT.

While the attenuation of telephone currents in their passage through a telephone line has been recognized in a general way for a long time, it is only within the last few years that there has been any real understanding of what takes place in a line. This knowledge has naturally led to a considerable number of suggestions and plans for improving transmission by doing away with the line wastes.

Messrs. W. F. Gradolph, of St. Louis, and W. C. Hahne, of Chicago, have looked upon these wastes largely as wattless currents expending themselves as I^2R losses, and they have conceived the idea that if the currents in the two limbs of a line can be kept equal and opposite in their instantaneous values then there will exist no reactance either of inductance or capacity between the conductors and, therefore, no reaction or wattless currents.

To approximate this result, they have arranged a circuit at the transmitting end with a split induction coil. One end of the coil is connected to one limb of the line and the other coil terminal is connected to an impedance coil, which in turn is connected to the second line limb. Thus far we have a single-phase system. To overcome this a third wire is connected to the middle point of the induction coil which is made of a length at least as great as one wave length of the telephone currents. This third wire is associated with the line limb opposite from the impedance coil.

It is claimed that the result is a phase distortion, the currents in one line limb being retarded and those of the other advanced. The receiving coils having inductance serve to bring back the currents toward conjunction. It is, of course, recognized by the inventors that opposition cannot be attained, but they contend that an advantage of transmission is gained which increases with the approach to opposition of phases in the line and with the approach toward conjunction in the receiving coil. The inventors show a complete system with automatic means for converting a station from a receiving to a transmitting station.

LETTERS TO THE EDITOR.

Electrical Shows.

To the Editor of Electrical World:

SIR:—The article on page 1692 of the issue of June 30, under the heading of "Electrical Shows," which contains figures relating to the recent Electrical Show in St. Louis, and states that 60 per cent of the payments for floor space by the exhibitors was rebated to them at the end of the Show, has just come to my attention.

The article is very misleading in that it does not point out the unusual circumstances which made possible this very large return to the exhibitors. The receipts—$12,301.25—are very carefully itemized, while the disbursements—$7,033.25—are not shown in detail, giving the impression that this latter amount included all items of expense incidental to this electrical show.

I am informed upon good authority that the St. Louis Electrical Show paid absolutely nothing for its booths and decorations. All of this material, used by the exhibitors at the last convention of the National Electric Light Association, was allowed to remain without cost to the Electrical Show. The amount paid for rent, I understand, was nominal and included the services of those connected with the Coliseum. Current was supplied to exhibitors to a liberal extent without charge, through the courtesy of the Union Electric Light & Power Company; and as the Show was administered under the auspices of the League of Electrical Interests, salary expenses were entirely eliminated. Considering the absence of these items of expense and possibly others, it would not seem that the Show referred to is a fair example for comparison.

We trust that it will be possible for you to publish a more detailed statement of the expenses incidental to the Show referred to in your article, that any false impressions deducted therefrom may be corrected.

New York. GEO. F. PARKER,
General Manager New York Electrical Show.

[The figures showing in detail the expenses of the St. Louis Show are not available for publication. We believe, however, that our correspondent is correct in his surmise that the total disbursement reported is much less than would be incident to a similar enterprise which has to bear in full every expense entailed in equipment and conduct. In New York City, for example, the item of rent for the annual Electrical Show is alone much greater than the total disbursement at St. Louis. —ED.]

Illumination from Window Light.

To the Editor of Electrical World:

SIR:—In your issue of June 30, page 1722, Mr. Joseph Thompson recommends the more general use of calculations of the illumination produced in a room by the light from such a surface source as a window. In this I agree with him. The reason why it is not done more frequently is presumably be-

cause such calculations are not generally understood, as very little, if any, useful information about them is found in text-books, and probably few illuminating engineers could say offhand how to make calculations of the candle-power, flux and illumination when the source is the sky, clouds or buildings outside of a window.

Mr. Thompson gives the rule that the illumination at any point in a room lit by a window "depends solely upon" or "varies exclusively with the product of" the "surface brilliancy of the window and the solid angle subtended by the window when viewed from that point," which he claims would "render unnecessary the many involved equations based on 'inverse squares' . . . always resorted to at present . . ."

Anyone attempting to make this calculation from his statement will not get far and will also find that Mr. Thompson is mistaken in believing this gets rid of the "inverse square" factor, for it merely transfers it to the calculation of the solid angle.

Moreover, his statement of that law is of the so-called "bob-tail" kind of solutions so common in books on physics—that is, it is just short of being of use in practice because it fails to state what the numerical units are and merely describes how the illumination "varies," but not what it really is equal to numerically. It is, therefore, of little or no use to the practical man who wants actual results. The term "surface brilliancy" is, in my opinion, an unfortunate and very indefinite one, especially when the units in terms of which it is expressed are omitted. Nor does Mr. Thompson call attention to the fact that the inaccuracies in this law become quite great for points near the window.

The numerical solution is as follows: Let it be found by measurement that each square foot of the window illuminates a point on a line perpendicular to it, just as much as n candles would if they replaced that square foot; this is readily measured with a photometer or an illuminometer. This figure takes the place of his "surface brilliancy." Multiply this by the number of square feet of the window. Then on any plane sufficiently far distant and parallel to the window the illumination in foot-candles will be equal to that product divided by the square of the distance in feet. Or, to use the method advocated by Mr. Thompson, multiply this n by the solid angle; but as this solid angle is the window area in square feet divided by the square of the distance from the illuminated plane to the window in feet, it will be seen that the numerical calculation is exactly the same and that nothing is gained. On the contrary, as the calculations of solid angles are not so generally understood as the inverse square law, the first method is, in my opinion, the one to be preferred.

It may be of interest to add here that the light flux passing through each square foot of such a window when expressed in spherical candle units of flux is equal numerically to one-fourth of this n, or when expressed in lumens it is equal to 3.14 times n. Each square foot of this window is, as a light-giving source, exactly equivalent to 1 sq. ft. of the sky, clouds, buildings, etc., from which the light comes, if that original surface is imagined to take the place of the window.

These and many other results concerning the less usual calculations of light flux, illumination, etc., were fully described in a paper by the writer entitled "Calculating and Comparing Lights from Various Sources," read before the Illuminating Engineering Society Oct. 5, 1908, in which all the results are expressed in such a form and in such units that they may be directly applied in actual cases.

Philadelphia, Pa. Carl Hering.

Digest of Current Electrical Literature

ABSTRACTS OF THE IMPORTANT ARTICLES APPEARING IN THE ELECTRICAL PERIODICAL PRESS OF THE WORLD

Generators, Motors and Transformers.

Single-Phase Alternators.—C. Pichelmayer.—An English translation of his recent German paper, which has already been noticed in the Digest. Means are described whereby the dangerous pressures, induced in the rotors of single-phase alternators by the inverse rotary field, can be avoided and the factor of safety of working of these machines made equal to that of polyphase machines.—Lond. *Electrician,* June 24.

Lamps and Lighting.

Physical Production of Light.—E. P. Hyde.—The first part of a paper read before the Franklin Institute in which the author considers briefly certain questions in physiological optics which determine the light-giving properties of radiant energy and then discusses the laws of radiation and the radiating properties of metals. Particular attention is given to various new methods for determining selective radiation, and data obtained by these new methods are presented.—*Journal Franklin Inst.,* June.

Metallic Filament.—A note on a recent British patent of R. Jahoda (15,496, 1909; June 16, 1910). Powdered tungsten is mixed with an organic binding agent and a small quantity of powdered copper or silver, or oxides or hydroxides of these metals. After squirting, the filaments are decarbonized at a high temperature in an atmosphere of hydrogen, and, although practically all the carbon is removed, the presence of the copper or silver gives the filaments the required strength, thereby enabling them to be handled with ease. During the sintering treatment the copper or silver is evaporated, thus leaving a pure tungsten filament.—Lond. *Elec. Eng'ing,* June 23.

Sockets for Incandescent Lamps.—M. Gerstmeyer.—The first part of an article in which the author states that some commercial lamp sockets are of such a construction that they may lead to accidents. He shows how the design can be improved upon. The article, which is illustrated by diagrams, is to be concluded.—*Zeit. f. Beleucht.* June 20.

Testing the Vacuum of Incandescent Lamps.—Louis Tiersot.—A description of a method of testing the vacuum of an incandescent lamp by means of high-frequency currents. It is common practice to test the vacuum by placing the lamp in a high-tension alternating field whereby fluorescence effects are obtained within the lamp. This method has the disadvantage that the globe is liable to be perforated by a spark and physiological effects may be produced on the man who holds the lamp. These disadvantages are overcome when high-frequency currents are employed, as they produce no physiological effects and it is possible to choose for the voltage a value so that fluorescence is produced in all cases and the lamp assumes a different color according to its degree of vacuum.—*Revue Polytechn. de Geneve,* May 10; abstracted in *L'Industrie Elec.,* June 25.

Generation, Transmission and Distribution.

Transformation of the Energy of Coal Into Electrical Energy.—E. J. Berg.—The author discusses the magnitude of the losses incidental to the transformation of the energy in coal into electrical energy. He discusses the specific losses of a 1000-kw steam-turbine station and gives the heat balance sheet as follows:

Heat Balance	Thermal Units	Per Cent
Boiler plant loss	4,390,500	20.0
High pressure steam pipe loss	352,500	1.6
Rotation losses, general	204,600	.9
Electrical output, general	3,410,000	15.6
Cooling water loss	13,489,600	61.4
Heat lost in feed water	105,800	.5
Total	21,953,000	100.0

Notes are added on the relative economy of steam heating from an independent low-pressure steam boiler and from the exhaust of the steam turbine. His calculations emphasize the desirability of heating by means of exhaust steam.—*Gen. Elec. Rev.,* July.

Exhaust-Steam Feed-Water Heater.—An illustrated description of a simple and inexpensive means by which the exhaust steam from auxiliary or other plant can be utilized to heat the feed water, and at the same time there can be recovered the pure water which might otherwise be wasted. To use this form of heater it is necessary merely to place it at the top of the hot-well tank or other reservoir generally used for the storage of feed-water, the top part of which should be closed to prevent radiation. The chief feature of the heater is that, although the exhaust steam is entirely surrounded by water, it is not under water-level at the outlet, so that there is no possibility of creating a back-pressure on the plant from which the exhaust is derived. This is accomplished by changing the form of the water, as it passes through the heater, from a solid bore at the inlet to a hollow "umbrella-shaped" film, having its base at the water-level in the tank. The exhaust steam, on entering the inner casing, is met by a few jets of water, which help to reduce the temperature of the steam, and then passes out of the heater into the space which is made by the water "umbrella." In trying to break through this film, which can be made of any desired thickness, it is completely condensed. The description applies to both types of heater illustrated in Fig. 1. The ordinary type is shown at the left. The automatic type shown at the right provides a means of regulating the water in the tank, when necessary, without interfering with the free discharge of exhaust steam. By removing the cap *A* the spring *B* can readily be adjusted. In most cases when the feed water has been checked the amount of exhaust steam is less than when the former was "full on," so that the whole arrangement with an automatic type of heater would be automatic.—Lond. *Elec. Rev.,* June 24.

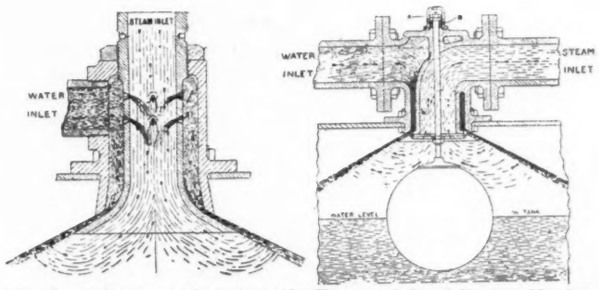


Fig. 1—Ordinary and Automatic Types of Feed-Water Heaters.

Load Regulator for Water-Power Stations.—F. SIMMERDING.—An illustrated description of the Wolff load-regulating system for water-power stations. The load is kept constant in such a way that the regulator adds load according to the variation of the speed. A centrifugal regulator acts on a lever by means of which the electrodes of a water resistor are more or less raised or lowered in the water so as to change the resistance. This water resistor is within the circuit of the generator driven by the turbine and the effect of the regulating system is that the load of the generator and of the turbine is maintained constant.—*Elek. und Masch.* (Vienna), June 12.

Turbo-Generators.—E. BRUNSWICK.—In a continuation of his long review of the present situation of the design of turbo-generators, the author discusses the design of direct-current generators directly driven by steam turbines, the special difficulties of their design, the relation of cost to speed, etc. The article is to be continued.—*L'Industrie Elec.,* June 25.

Control of Electrically Driven Machine Tools.—A note on a recent British patent (27,026, 1909; June 16, 1910) of A. J. Boult and the Felten & Guilleaume-Lahmeyerwerke. In large high-speed reversing machine tools, such as planing and mortising machines, the driving motor is reversed at the end of the travel by gradually reducing the speed of the motor by means of stops attached to the table of the machine. These stops can work switches to increase the field magnetism of the motor by short-circuiting resistors in the field circuit. The gear is arranged so that the slightest movement in the opposite direction opens all the switches, thereby making the control of the motor when speeding up dependent solely on the starting gear.—Lond. *Elec. Eng'ing,* June 23.

Equalizing the Fluctuations of Load.—A. REISSET.—With reference to a recent review of the different methods of equalizing the fluctuations of load in main-shaft winding in mines and in the electric drive of rolling mills the author describes two new systems of the Brown-Boveri Company.—*La Lumière Elec.,* June 25.

Hydroelectric Stations.—F. KOESTER.—In a continuation of his serial on hydroelectric practice the author now takes up the discussion of the electrical machinery, generators, switchboard, and general electric-station equipment.—*Eng. Mag.,* July.

Electric Energy Supply in Great Britain.—A statistical table of electric energy supply stations in Great Britain, giving the principal data of equipment, rates, etc., for 118 different stations.—Supplement to Lond. *Electrician,* June 24.

British Central Stations.—A large table giving statistical data on the electric central stations of the United Kingdom. Data are given on the history, equipment, etc., of 457 stations.—Supplement to Lond. *Elec. Review,* June 24.

Traction.

Multiple-Unit Control.—C. RENSHAW.—A paper read before the Street Railway Association of the State of New York on recent developments in multiple-unit control and other electric apparatus, especially the application of the acetylene welding process to the manufacture of sheet-steel gear cases, and the application of forced ventilation for railway motors.—*Elec. Rail. Jour.,* July 2.

Brake-Shoe Standardization.—J. A. PANTON.—An abstract of a paper read before the Tramways and Light Railways Association at the Dublin Congress. Attention is first called to the large amount of waste in connection with brake-heads and blocks. The author then discusses the properties of the various types of brake blocks, and finally suggests a standard design which, he claims, will show a saving of over 100 per cent in material.—Lond. *Electrician,* June 24.

Electric Propulsion of Ships.—A note on a recent British patent (19,872, 1909; June 16, 1910) of the British Thomson-Houston Company (General Electric Company of this country). High-speed turbo-alternator sets supply three-phase currents to induction motors, the rotors of which are mounted on the propeller shafts. On each shaft is also a low-pressure, low-speed turbine. For high speeds of the ship, the turbines of the generating sets exhaust into the low-pressure turbines, and both these and the motors drive the ship. For cruising speeds, the low-pressure turbines are run in a vacuum or are disconnected from the shaft, and the ship is driven by the motors only, the turbo sets exhausting directly into the condensers. Arrangements for pole-changing the motor windings permit of speed variation.—Lond. *Elec. Eng'ing,* June 23.

Installations, Systems and Appliances.

Calculating the Cost of Electric Energy.—W. WUNDER.—A paper read before the Association of German Electricity Stations in Nurnberg. The author compares two methods of calculating the cost of electric energy. The common feature of both methods is that the expenses are divided into two classes, namely, first, those which are proportional to the kw-hours (direct cost, variable cost), and second, the costs which increase with the maximum load in kilowatts (indirect cost, fixed cost). The two methods discussed differ in so far as in the first method the items of management, interest, amortization, etc., are taken from the books to calculate the indirect cost and the items of cost of materials of operation, wages, and maintenance, are also taken from the books and summed up to give the direct cost. In the second method, that of Wright, the separation into fixed and variable costs is made by an empirical method. The second method is employed by the Upper Silesia Electricity Works and has proven very successful. The author claims that the second method is more accurate. A plant which calculates the cost according to the first method is liable to sell energy to offices at too low a cost and will not be able, on the other hand, to reach the very large consumers. As to the tariff the author thinks that for residence

lighting the greatest profit can be obtained if the price of energy is taken so low that even the residence of the less well-to-do people can be served. It is recommended to supply groups of consumers at unit rates and to sell energy to large consumers according to the Wright maximum-demand system with switches which disconnect the consumer at certain hours. For small industrial consumers a double tariff is recommended. —*Elek. Zeit.*, June 23.

Central-Station Economy.—An account of a discussion at the recent meeting of the (British) Municipal Electrical Association, on the advantages of continuous records of costs and of steam consumption. It was opened by G. Silkinson, who insisted particularly on the undesirability of feeding into the economizers at too high a temperature and explained that he obtained greater efficiency by returning the condensed water from the steam traps, etc., directly to the boiler instead of taking it to the feed tank. Shawfield, who followed, gave an instance to show the practical value of continuous tests. He was not in favor of returning the condensed water directly to the boiler, as he preferred to measure it, and thus obtain an indication as to defects in the lagging or arrangement of the steam pipes. He had, however, not had good experience with CO_2 recorders. Ayton, Wordingham and Ruddle all thought that there is danger of the taking of records in stations being overdone. Ayton's experience with CO_2 recorders coincided with that of Shawfield, and he explained the probable cause of the trouble and the remedy he is trying. He also described the methods he uses to prevent air leakages into the furnaces and flues, a point which had also been raised by Wilkinson. Newington described some tests he had made on the moisture in coal; Lea related some interesting experiences which had led him to evolve his water recorder, and complained that plant running is not taught at engineering colleges; and, finally, Rowland expressed a high opinion of the CO_2 recorder, which instrument, he said, has led to economies at Stretford.—Lond. *Elec. Eng'ing*, June 23.

Trient.—E. Rudolph.—The first part of a paper read before the Electrical Society in Vienna on the electricity works of the city of Trient in Austria. The first station was opened in 1890, the Fersina water-power being utilized. There were six 140-hp, 550-volt, direct-current generators supplying energy to a 4 x 115-volt 5-wire lighting system of 5500 incandescent lamps. When the load increased, a 150-hp, steam-driven, direct-current generator was installed as reserve in the municipal gas plant. Later on the network was modified in so far as the outers of the five-wire system with an e.m.f. of 500 volts were used for motor service, while the three middle wires with 2 x 220 volts were used for the lighting system. As soon as the load further increased an entirely new hydroelectric station was erected at the Sarca River. This was opened last year. It contains three 1500-hp turbines, each driving a 1250-kva, three-phase generator, the e.m.f. being 5250 volts and the frequency 50 cycles. The article is to be continued.—*Elek. und Masch.* (Vienna), June 26.

Determination of Resistance Steps.—E. R. Carichoff and H. Pender.—A mathematical article discussing the following problem. Given the speed-current curve of a motor corresponding to line the voltage; the current at which the controller is to be advanced, and the number of steps in the starting resistor, to find the proper resistances of the resistors such that the current is taken by the motor at the instant of advance of controller from one step to the next shall be the same for each point of the controller. The exact mathematical theory is given and the analytical solution is applied to various special cases.—*Gen. Elec. Rev.*, July.

Switchboard.—F. Heinicke.—An illustrated description of the switchboard of the high-tension, three-phase system of the Chorzow station of the Upper Silesia Electricity Works generating three-phase currents at 3 x 6000 volts, the total generating rating being 23,000 kw. The switchboard is of the most modern design. It is in a building separate from the machine house and is subdivided into three stories. Great care has been taken to insure as much as possible its reliability under all conditions of service and the safety of the attendants.—*Elek. Zeit.*, June 23.

Synchronizing Alternators.—J. Teichmueller.—An English translation of his recent German article on the relative sensitiveness of the different methods of lamp connections used in synchronizing alternators.—Lond. *Electrician*, June 24.

Aerial, Underground and Interior Circuits.

Costs of Mains and Services.—An account of the discussion before the (British) Municipal Electrical Association on cheapening the costs of mains and services which was opened by S. J. Watson and Ayton. Some valuable figures were given as to the cost of service connections. In Glasgow they average $21.60, but a few years ago they were actually $35. Some speakers explained why they had been successful in reducing the cost of services. An extended use of looping-in was also advocated, and one suggested that it would be worth while in some cases to lay the services at the same time as the mains.—Lond. *Elec. Eng'ing*, June 23.

Electrophysics and Magnetism.

Magnetostriction.—H. G. Dorsey.—An account of an experimental investigation of magnetostriction in iron-carbon alloys in which the carbon varied from 0.058 per cent to 1.37 per cent, while the amount of phosphorus, silicon, manganese and silver was low and approximately constant. The maximum elongation decreases with the carbon content to 0.9 per cent carbon and then increases. In a somewhat similar manner, but not so definitely, the value of H at which the rods retract to their original length drops to a minimum value at about 0.9 per cent carbon. Up to field strength of about 1600 the rods were still contracting at individual uniform rates. However, for a field strength of 1500 it may be said in a general way that the greater the carbon content the less the retraction. The modulus of elasticity decreases with carbon, or, the amount of shortening in strong fields varies directly as the modulus. Steels slowly cooled have greater elongations and susceptibilities than when quenched. Accidental exceptions are found in soft iron. Magnetostriction depends upon the previous history of the specimen. The percentage elongation in the middle of a 40-cm rod of soft iron is nearly three times as much as for the entire rod. Rods of different lengths of the same quality of iron give different values, and hence absolute values of magnetostriction as determined by different workers are not comparable with each other unless experiments are made with rings or else some method of correction is devised.—*Phys. Rev.*, June.

Luminescence.—C. A. Pierce.—An account of an experimental investigation of the distribution of energy in the luminescence spectrum of sidot blende. The results of the experiments show that the energy curve of the fluorescence light of Sidot blende consists of a band extending from about $\mu = 0.46$ to $\mu = 0.60$, having a maximum at $\mu = 0.55$. There may be another band situated in the region of longer wave lengths. Furthermore, the energy distribution in the fluorescence light and in the phosphorescence light immediately after excitation is the same. Further experiments are now being carried on by the writer to find whether any change in the energy curve takes place during decay, or is brought about by the influence of infra-red rays or by other means.—*Phys. Rev.*, June.

Elementary Quantum of Electricity.—A. E. Haes.—A paper on the new theoretical method for calculating the elementary quantum of electricity and the radius of the hydrogen atom. The former is found to be 3.18×10^{-10} electrostatic units and the latter is 1.88×10^{-8} cm.—*Phys. Zeit.*, June 15.

Inductance of Metal Tube.—F. W. Grover.—An abstract of an American Physical Society paper in which the author gave several more accurate formulas than had heretofore been developed for the inductance of a metal tube bent into the form of a circular ring.—*Phys. Rev.*, June.

Electrochemistry and Batteries.

Refining Bismuth.—F. Foerster and E. Schwabe.—In the electrolytic refining of lead by the Betts process the anode slime contains silver and bismuth. The present authors pro-

pose to subject this silver-bismuth to a further refining process in a silico-fluoride solution of bismuth as electrolyte. Pure bismuth is deposited on the cathode. The lead contained in the anode passes into the electrolyte. The silver remains back at the anode. The bismuth deposited on the cathode is free from lead.—*Zeit. f. Electrochemie,* April 15; abstracted in *Met. and Chem. Eng'ing,* July.

Units, Measurements and Instruments.

Measurement of Magnetic Fluxes.—W. PEUKERT.—The property of bismuth of changing its electric conductivity in a magnetic field has already been used for measuring magnetic fluxes. The author proposes to utilize another property of bismuth, namely, the Hall phenomenon. The principle is shown in Fig. 2. The current *i* passes from the battery *E* through a

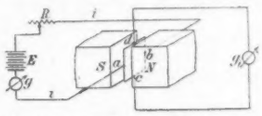


Fig. 2—Measurement of Magnetic Fluxes.

bismuth plate, *abcd,* the connections of the wire of the bismuth plate being made at the points *a* and *b*. Two other points, *c* and *d*, are so chosen that when they are connected by a wire to the galvanometer g_1 no current passes through g_1—that is, the two points *c* and *d* have the same potential. If, now, the electromagnet *NS* is excited so that the bismuth plate is within a magnetic field a current passes from *c* to *d* through g_1 and the potential difference between *c* and *d* is approximately proportional to the current *i* and the flux *H*, and inversely proportional to the thickness of the plate. In the experiments of the author a bismuth plate of the dimensions 68 mm x 28 mm x 1 mm was used. Since the thickness is constant the potential difference between *c* and *d* should be directly proportional to the magnetic flux *H* when the current *i* is kept constant, assuming that the above rule will hold strictly true. In reality, however, the relation between magnetic flux and e.m.f. between *c* and *d* differs somewhat from a straight line. The exact error may be determined experimentally and then used in the calibration of the instrument. By changing the current *i* the calibration curve is not changed, since there is an exact straight-line relation between the primary current *i* and the e.m.f. between *c* and *d*. By changing the current *i* the scale of the instrument can be widely varied.—*Elek. Zeit.,* June 23.

Surface Bolometer.—E. F. NORTHRUP.—An abstract of a paper read before the American Physical Society on a special type of surface bolometer for total radiation experiments. The apparatus consists essentially of two flat spirals of very fine insulated wire which form two arms of a Wheatstone bridge. The flat spirals used are each 4.5 cm in diameter. They are wound with 2-mil silk-insulated nickel wire and cemented to very thin sheets of mica. These flat-disk spirals are mounted with their faces opposed in a box which replaces a Lummer-Brodhun screen on a photometer bench. When equal radiation from two incandescent lamps falls on the two disks, the Wheatstone bridge is balanced. If one lamp gives more total radiation than the other the balance of the bridge is restored by moving the bolometer along the photometer bench to obtain the balance in precisely the same way as a Lummer-Brodhun is moved to obtain a balance for equal luminosity. Thus the device enables the total radiation to two sources to be compared with great sensitiveness in the same manner as a photometer screen allows the luminous radiation of two sources to be compared. The surface bolometer has the advantages over the thermopile in being more sensitive, in being able to have the sensitiveness adjusted by varying the current through the bridge, in permitting a balance to be obtained (giving a null method) by varying the resistance along a slide wire, and in having an exceedingly small thermal-capacity and time-lag as compared with a thermopile. The instrument may be modified to read radiation in absolute measure and hence become a pyrheliometer. It may be adapted for use as a sensitive and accurate recorder, and gives promise of being adapted for use as a radiation pyrometer.—*Phys. Rev.,* June.

Measuring the Speed of Rotation.—E. B. BROWN.—A description of an accurate electrical method of measuring the speeds of rotation by means of a modification of the condenser method. The main feature is the use of a special type of differential galvanometer. By means of a rotating commutator a condenser is alternately charged by a battery and discharged through one coil of a differential galvanometer. The steady deflection which would exist due to the rapid succession of discharges is opposed and prevented by a steady current from the same battery passing through the second coil of the differential galvanometer. This steady current is adjusted by variable resistance in series until the galvanometer is restored to its zero position. The ratio of the steady current to the mean value of the pulsating current will be a constant for the instrument, but the steady current is equal to the potential difference of the battery terminals divided by the total resistance exterior to the battery, while the mean value of the pulsating current is equal to the product of the potential difference of the battery terminals, the capacity of the condenser and the number of discharges per second. If the capacity of the condenser may be regarded as constant, the reciprocal of the total resistance in the steady current circuit must be proportional to the speed of rotation when the galvanometer shows no deflection, the battery potential difference being eliminated. The speed of rotation may then be calculated by dividing a constant by the resistance in circuit. The special feature of the galvanometer employed is the large ratio between the number of turns in the two windings. This enables series resistance of moderate value to be used instead of the very large and expensive resistances which would be necessary with an ordinary differential galvanometer. The connections are shown in Fig. 3, where the two coils of the differential galvanometer are represented by *M* and *C*, and the commutator by the arrowheads *D* and *A* and *E*. Of these *A*, attached to one terminal of the condenser *K*, alternately makes contact with *D* and *E*, thereby charging and discharging the condenser. *B* is the battery and *T* the series resistor. If *F* be connected to *H* the condenser discharges pass through the coil *C*, but if *F* be disconnected from *H* and connected to *L*, the charging currents pass through *C*. Both methods of connection give the same value of the capacity within the limits of errors of observation. The experiments of the author show that, corresponding to every value of the speed, there is a definite value of the series

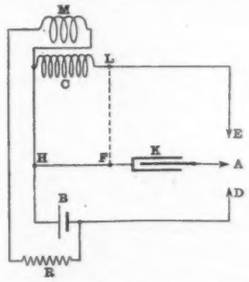


Fig. 3—Diagram of Connections.

resistor which will bring the galvanometer to zero. As far as the adjustment is concerned the value of the battery e.m.f. is immaterial, except that increasing it increases the sensitiveness of the arrangement.—Lond. *Electrician,* June 24.

Measurement of Thermal Conductivity.—J. K. CLEMENT AND W. L. EGY.—A method of measuring the thermal conductivity of fireclay in which a known quantity of heat is generated by means of an electric heating circuit in such a manner that all the heat generated must flow through the substance tested. If a constant quantity of heat is generated until conditions have reached an equilibrium then the quantity of heat conducted through the material per second must be equal to the quantity generated per second. This method may be used with a heating coil either in a hollow sphere or in a long cylinder. The latter form was chosen for the tests because of the ex-

perimental difficulties arising in the former. From the electrical measurement of this heat and from temperature measurements by means of thermo-couples the thermal conductivity is determined.—*Met. and Chem. Eng'ing,* July.

Boiler Tests.—C. E. Larard.—A very full discussion of a proper boiler test installation and the economical combustion of fuel. In the concluding instalment various types of pyrometers and recording instruments are described.—Lond. *Engineering,* June 3, 17 and 24.

Induction Coil.—J. K. A. Wertheim-Salomonson.—An account of an experimental and theoretical investigation of the oscillations observed in the oscillographic study of the primary current wave of an induction coil.—*Phys. Zeit.,* June 15.

Telegraphy, Telephony and Signals.

Telephone Disturbances from Earthen Three-Phase Systems.—E. Von Holstein-Rathlou.—At one of the central stations of Copenhagen a large new three-phase cable network, operated at 60,000 volts, was recently opened to supply part of the suburbs with electricity. The station contains two 2500-kw turbo-generators wound for 6000 volts and 50 cycles and two synchronous motor generators each of 250 kw at 6000 volts. The neutral point of one of the large generators was earthed. It was found that considerable disturbances occurred in the telephone lines in the suburbs, and it became necessary to remove the earth connections. The telephone company in Copenhagen uses a double conductor within the center of the town, but in the suburbs operates at present with only one conductor and with the earth as return. The causes of the disturbances were investigated in detail and it was found that currents of considerable magnitude (5 amp) passed through the earthing conductor into the earth. Due to the three capacities between the three phases of the cable with respect to earth currents representing harmonics of triple frequencies and multiples thereof enter into the earth. These pass back through the earth to the earth connection at the generating station and may thus cause trouble.—*Elek. Zeit.,* June 23.

Miscellaneous.

British Municipal Electrical Association.—The annual report of the council shows that the membership of the association now stands at 416, made up as follows: Municipal electrical committees (members), 170; chief electrical engineers (members), 191; honorary members, 3; chief assistants (associate members), 11; assistants (associates), 41. There is an increase of 26 on last year's total. The sub-committee on physical standards of the engineering standards committee, upon which the association is represented, has in hand at the present moment standard specifications for bayonet-socket electric lampholders, and a specification for metal-filament lamps. J. Christie, chief electrical engineer to the Brighton Corporation, is the new president.—Lond. *Electrician* and *Elec. Rev.,* June 24.

Free Trade and Protection.—The speeches made in the recent debate in London on the effects of free trade and protection upon the electrical industry are given in full in Lond. *Elec. Rev.,* May 27 and June 3.

Book Reviews

Exporters' Encyclopædia. 1910. Complete Export Shipping Guide. New York: Exporters' Encyclopædia Company. 800 pages. Price, $5.

This book is a useful guide for those who ship goods to foreign countries. It contains detailed information on shipping routes, customs regulations, and all special information necessary for all foreign countries. General directions for making foreign shipments are also given. The general information, which includes shipping directions, foreign weight and money conversion tables, postage rates, etc., is followed by a section on specific shipping directions classified under countries, which are arranged alphabetically. The subscription price includes monthly correction sheets, which keep the guide up to date.

Erecting Work. Herbert E. Collins. New York: McGraw-Hill Book Company. 140 pages, 110 illustrations. Price, $1.

The present volume is one of the Power Handbooks and is based upon articles that have appeared in *Power.* The work is intended for millwrights, erecting engineers and others which have to install machinery. The laying of foundations, unloading, handling and erecting of heavy machinery and directions for building home-made hoists, tieing knots and making hitches are among the things treated. The book is exceedingly practical and should be of use to men in small and medium-sized stations where the operatives are occasionally called upon to move heavy machinery and no special appliances for such work, such as overhead cranes, are at hand.

The Electrician Electrical Trades Directory and Handbook. 2 vols. London: The Electrician Printing & Publishing Company, Limited. 2000 pages. 18s. 6d.

The present is the twenty-eighth edition of the "Blue Book," as it is familiarly called. As usual, it contains a record of the year's progress in the electrical industry, the laws and regulations of different countries which are of interest to the electrical industry are brought up to date, and financial details and organization of electrical corporations given. In the directory division is listed practically every person engaged in the electrical business in the United Kingdom. Sections of the directory are devoted to the British Colonies, the Continent of Europe, Asia and Africa, Central and South America, and the United States. In addition to the usual alphabetical and classified trades divisions, there are sections giving particulars of all the chief officials engaged in the electrical, telegraph, railway and works departments of the governments of the world. A biographical section gives sketches of leading men in matters electrical, and obituary notices of those who died during 1909. A tabulated central-station directory for the United Kingdom is printed in a separate pamphlet, which is folded and inserted in a pocket in the directory volume. One of the central-station tables is devoted to Colonial and foreign enterprises.

Universal Electrical Directory, 1910. A complete record of all the industries directly or indirectly connected with electricity and magnetism. London: H. Alabaster, Gatehouse & Company. 1538 pages. Price, 18s.

The present is the twenty-ninth edition of the "Red Book," which is too well known to require more than an announcement. The present edition contains 33,095 selected names, unimportant ones being omitted. These names are divided as follows: Great Britain, 13,192; Colonies, 5400; Continental, 8037, and the United States, 6466. The four sections are arranged both alphabetically and topically. In addition to this the British firms are arranged geographically, this being done this year for the first time. The topical arrangement of the British section is more detailed than in the other sections, and it is to be hoped that this subdivision of topics will be carried still further in the next edition. There are many specialties made nowadays under trade names which are completely lost in a general classification. This directory, in common with all the others, fails more or less when it is desired to look up the manufacturers of some specialty, such as, for instance, a particular brand of insulating material. The topics could with advantage be further subdivided and under the name of the manufacturer any specialties which are generally known under a trade name might be mentioned.

Messungen an Maschinen und Motoren für Wechselstrom. By Fritz Hoppe. Leipzig: Johann Ambrosius Barth. 166 pages, 190 ills. Price, 5.80 marks.

The present volume is No. 9 in the series of electrotechnical text-books issued by the same publisher. Like all the books in the series it is written for the practical man and mathematical demonstrations are used as little as possible. Enough of the theory of the machines is given to explain in each case the meaning of the tests which are described. The work is limited

to alternators, synchronous and induction motors, and synchronous converters. Single-phase commutator motors are not treated as they are seldom used except in traction work. The work necessarily contains some mathematics, but most of the explanations are made with the aid of vector diagrams, the Behrend-Heyland diagram being used with the polyphase induction motor.

AUTO-TRANSFORMER DESIGN. A practical handbook for manufacturers, contractors and wiremen. By Alfred H. Avery. New York: Spon & Chamberlain. 60 pages, 24 ills. Price, $1.50.

Metallic-filament lamps, on account of the comparatively low resistance of the filaments, are well adapted for voltages lower than those commonly used with carbon filaments, and it is often desirable to install low-voltage lamps for use with a small transformer. The present book discusses briefly the lamp problem and gives directions for designing and building a line of auto-transformers of small size for use in connection with metallic-filament lamps.

New Apparatus and Appliances

MAKING HARD RUBBER FOR TELEPHONE PURPOSES.

BY F. S. MALM.

The Western Electric Company has found that it is able to save a considerable profit that formerly went to middlemen by making its own hard rubber for telephone purposes and at the same time is enabled to assure its customers as to the quality of this portion of its manufactured product. Para rubber, which the Western Electric Company uses, comes in the form of large biscuits which possess an odor similar to smoked ham, and it has a strength and elasticity which is unapproached by any other grade of rubber. It contains approximately 20 per cent of water, as well as a small amount of dirt and other impurities which must be entirely eliminated before it can be used in hard rubber manufacture. The crude rubber is first softened in hot water, this being done in a large steel tank with a capacity of several tons. The washing equipment consists of washing mills, provided with corrugated rolls, and a water pipe carrying wash water running parallel to the rolls along their whole length. The pipes are perforated and thus allow a constant stream of water to play upon the rubber while it is being passed between the rolls. The time required to wash crude rubber properly will depend upon its condition, as in every instance all contamination of hard rubber with such injurious substances as sand and bark must be removed. After the rubber has been thoroughly washed it is passed between the rolls of a finishing mill where it is rolled down to a thickness of ⅛ in., after which the sheets are dried in a large drying room in which the temperature may be controlled.

Hard or soft rubber can be made by varying the percentage of sulphur, but the proportion 40 per cent of sulphur and 60 per cent of rubber, vulcanized at the proper temperature, will produce the best hard rubber. The combination of sulphur and rubber is brought about mainly by heat, and no vulcanizing action takes place below the melting point of sulphur (238 deg.), and this action proceeds very slowly at temperatures under 250 deg. Fahr. When a piece of rubber is vulcanized properly with sulphur, no evidence of sulphur can be seen in the piece. When hard rubber contains more than 33 per cent of sulphur the balance will remain in the free state.

In making hard rubber at the Western Electric plant, the requisite kinds of rubber and the required percentage of sulphur are weighed out and thoroughly mixed in mills. The resulting mixture is cut from the mills, rolled into convenient sized lots and is taken to the various departments where it is to be made into hard-rubber parts. Hard-rubber sheets are made by warming up on the mill and calendering the rubber to size. Calenders are shown in the background of Fig. 1. The equipment consists of a large calender, which is a machine used for rolling the rubber out into a definite sized sheet. The sheets of rubber are in turn placed in cars and put into large vulcanizers. These vulcanizers are heated by steam, the heat being increased very carefully and gradually. The length of vulcanization depends, of course, upon the size and quality of the sheets to be made. The product of vulcanization now becomes a sheet which is hard and elastic and which possesses a beautifully polished surface. Upon cooling sheets are trimmed, if necessary, and sometimes buffed and polished. As a final operation these sheets are inspected and carefully gaged for size. A view of the inspection department is given in Fig. 2.

Fig. 1—Part of Vulcanizing Room.

Fig. 2—Rubber Inspection Department.

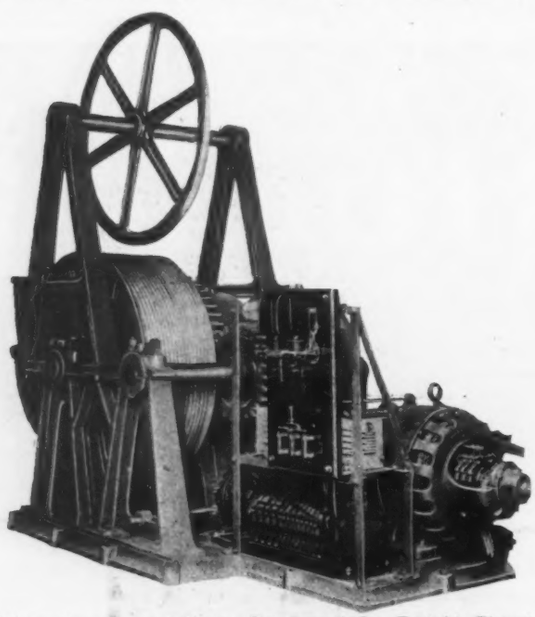
Rods and tubes are made from rubber mixtures on regular tube machines, which consist of a steam-jacketed cylinder in which a forcing screw is revolved, causing the rubber which is fed into the cylinder to be squirted out through a sizing die. After this operation they are vulcanized in similar vulcanizers to those in which sheets are made. The tubes are made similar to rods with the exception that the central hole is formed by

the aid of a pin in the tubing machine. After leaving the tubing machine the tubes are placed on steel rods on which they are vulcanized to obtain a tube with a hole of definite size. The rods and tubes after vulcanizing are finished to size and if necessary buffed and polished. The finishing is done on special polishing and buffing wheels, using different kinds of polishing agents to obtain the desired finish on the various grades of rubber.

Hard-rubber receiver parts are made from rubber mixtures which are milled and calendered as for sheets. These sheets are then cut into blank pieces which are placed into metal dies, pressed into the required shape and vulcanized. The dies in which these parts are vulcanized are placed in a steel form so arranged that a certain number of dies can be heated at the same time. The mixtures of rubber used are, of course, adapted to the particular use to which the parts are put. These dies are held to the most exacting dimensions of the modern tool room, to eliminate the possibilities of any defective workmanship which might result in the making of hard-rubber parts from these. After the parts have been vulcanized they are removed from the dies and put through the finishing operation, which consists in bringing them down to size with the assistance of every possible labor-saving machinery.

AN ALTERNATING-CURRENT ELECTRIC FREIGHT ELEVATOR INSTALLATION.

The accompanying illustration shows the simplicity and compactness of the motor equipment necessary to operate an electric elevator. The cable drum, the controller, and the motor can all be so placed together as to occupy very little space, and the entire plant requires practically no attention. Two of these freight elevators were recently installed at the Charleston Navy Yard by Mr. John B. Adt, Baltimore, Md. Each machine has a lifting capacity of 5000 lb. and weighs 12,000 lb. net. The hoisting machine is of the tandem worm-gear construction. The bronze worm wheels engage each other and right and left worms placed tandem on one shaft in a double housing. As the thrust is absorbed in the right and left worms, thrust bearings are not necessary. The worms are submerged in oil.



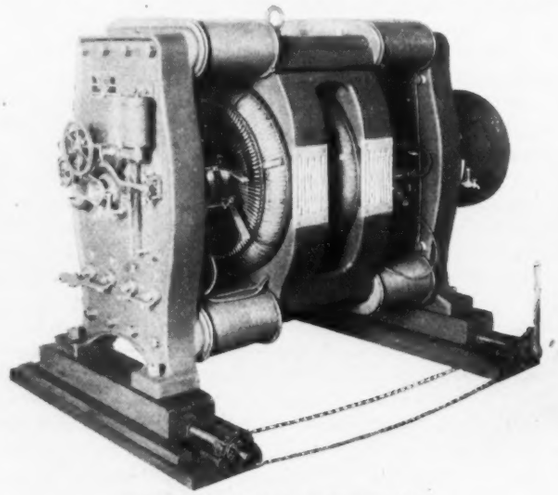
Alternating-Current Motor Equipment for Freight Elevator.

Heavy spur gears transmit the power to the winding drum. An effective brake, quick-acting, with two parallel-moving, leather-lined shoes, is attached to the work shaft. Automatic terminal stop appliances, as well as a slack-cable device, are attached to the front of the worm-gear housing, where they are all readily accessible for adjustment.

A Westinghouse 15-hp reversing induction motor, designed to operate on a three-phase, 220-volt, 60-cycle circuit, is direct-connected to the worm shaft and runs at 860 r.p.m. This type of induction motor is suited for applications where a strong starting effort is needed, and where induction motors of the squirrel-cage type would take so much starting current as seriously to disturb the line voltage. The motor is started by throwing the full-line voltage upon the primary; the speed is then increased by reducing the resistance in series with the secondary. The starting, reversing and acceleration are accomplished through the automatic controller shown in the illustration. The hoist frame, the motor, and the controller are all bolted to a substantial, one-piece bed plate.

MODERN ARC GENERATOR EMBODIES EARLY DESIGN.

One hundred of the new type of magnetite arc lamps being brought out by the Ft. Wayne Electric Works will be added to the present magnetite-arc street lighting of Ft. Wayne, Ind. These lamps are of the 4-amp type, and for supplying them



Modern Generator of Old Design.

with energy it is interesting to note that the Ft. Wayne Electric Works have recently completed the construction of a series-arc generator, all the essential features of which follow a design made in June, 1880, by Mr. J. J. Wood, who also designed the new magnetite lamps. The generator is of the double-circuit type, producing 7500 volts on each side.

ELECTRIC LIGHTING SYSTEM FOR AUTOMOBILES.

The use of electricity in side and tail lamps on practically all new high-priced cars is becoming quite common. Even among lower-priced cars some makers are furnishing electric lamps as standard equipment. Tungsten lamps and the production of

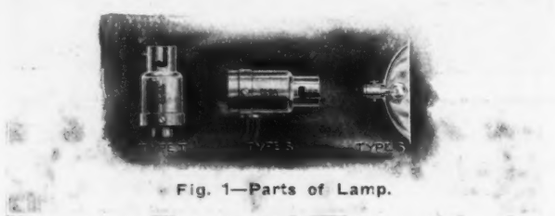


Fig. 1—Parts of Lamp.

suitable batteries made electric lighting a practical proposition. The fact that lamps fitted with Edison base would shake loose in sockets caused much unreliability and annoyance, however. The Willard Storage Battery Company, of Cleveland, Ohio, has given a new impetus to electric lighting by designing a socket in which the lamp does not depend on friction to hold it in

position. This socket requires lamps fitted with Edi-Swan base. The pins on this style of base engage a bayonet catch on the socket, the lamp being firmly locked in place by substantial plungers which also carry energy to the lamp. For headlamps a socket is used which slips into a sleeve at the apex of the parabolic reflector. The socket may be moved forward or

Fig. 2—Socket and Attachment Plug.

backward for adjustment of focus and securely locked in place by means of a compression clamp. In side and tail lamps a double-end socket is placed in a vertical position, one end carrying the lamp and the other engaging an attachment plug also fitted with pins similar to those on the lamp base. Manufacturers of tungsten lamps now make them also with the Edi-Swan base.

METER PROTECTIVE DEVICES.

The Metropolitan Engineering Company, of Brooklyn, N. Y., in an effort to prevent the theft of unmetered energy has

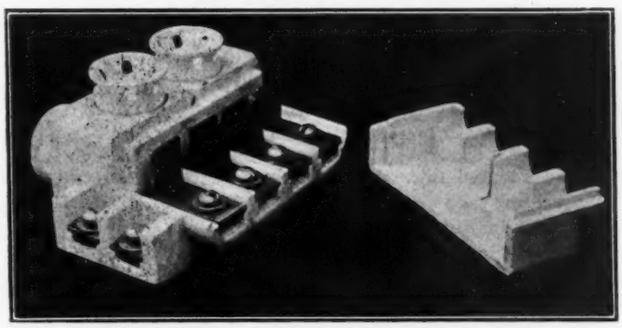


Fig. 1—Two-Wire Sealable Combination Service and Meter Testing Block

developed a sealable service cut-out equipped with a superior type of approved fuse so constructed that it may be refilled indefinitely at low cost. This service cut-out is used in con-

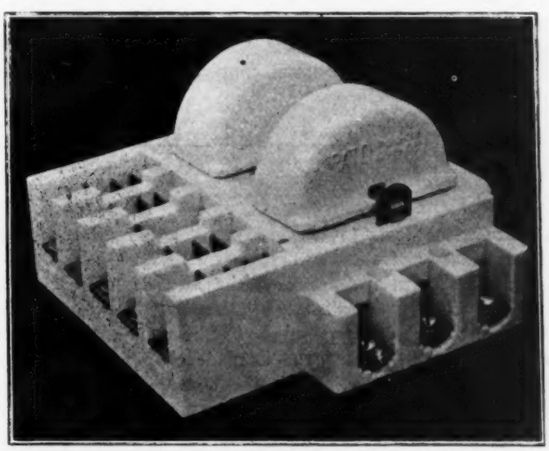


Fig. 2—Three-Wire Sealable Combination Service and Meter Testing Block.

junction with flexible or rigid metallic conduit and wiring frames adaptable to all types of meters. This makes an excellent tamper-proof service installation. The fuse is placed in an hermetically-sealed porcelain enclosure possessing several distinctive features. It has been approved by the National Board of Fire Underwriters and will withstand disruptive effects to a high degree. The receptacle for the fuse is also a departure from ordinary practice in that the barrier scheme of protection between opposite polarities is incorporated and with the U-form of fuse makes a service cut-out admirably adapted for low-tension work. The service switch lends itself to installations of all characters and it has been modified for other uses, and in combination with panel boards for local distribution on building risers, and for meter testing devices both

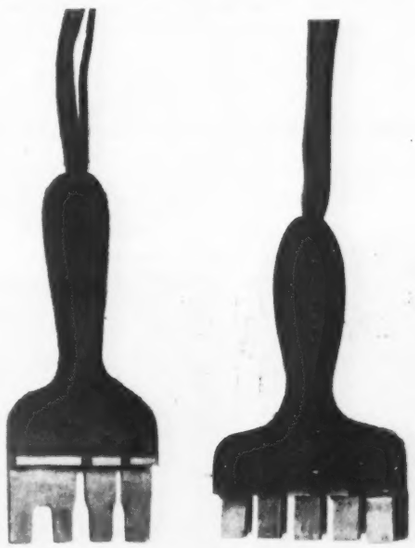


Fig. 3—Two and Three-Wire Meter Test Plugs.

separately and in combination as the controlling switch of the installation. The company has also devoted considerable time during the past 18 months to the development of several other devices intended not only to prevent theft of energy, but to combine the facilities of a meter testing cut-out in the same device; thus greatly simplifying meter testing by saving time in making connections for such tests. They also make possible an increase of at least 40 per cent in the number of meters tested in a given time and at the same time obviate the usual annoyance to the consumer due to interruption of service while the test is in progress. Another advantage of this device is that

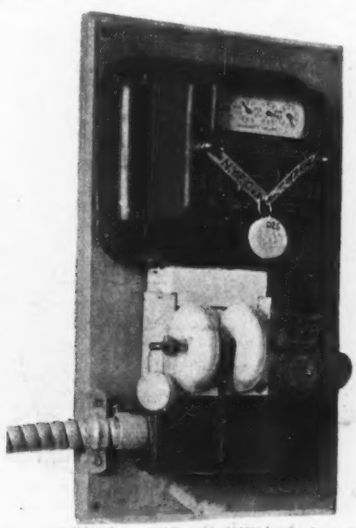


Fig. 4—Application of Meter Protective Devices.

the meter and device may be wired in advance and sent to the job ready for immediate connection. This also saves time and expense as the lineman can make the connections himself without the assistance of an expert meter man. Fig. 3 shows two-wire and three-wire testing plugs already wired and used

in connection with the testing block forming part of the service installation. When the test is to be made, it is only necessary to insert the testing plug and then remove the strap which is in use under service conditions. It is impossible to insert the plugs incorrectly in the cut-out. This is of value particularly where polyphase currents are metered, and precludes the possibility of a test under any other than approved methods. Here again greatly increased efficiency is possible in the tester's work. It is also impossible to make a short circuit, the device being practically foolproof. The line of porcelain protective devices was designed by Mr. Thomas E. Murray.

AMMUNITION HOIST CONTROLLER.

An ammunition-hoist controller built for Government purposes by the Ward Leonard Electric Company, of Bronxville, N. Y., is illustrated in Figs. 1 and 2. The apparatus consists of a four-pole reversing switch, a no-voltage and overload release starter with field controller and a dynamic brake attachment. A movement of the lever on the outside of the enclosing case in the up position causes hoisting of the ammunition and throwing the lever in the downward position causes a lowering of the load. All parts on the face of the panel are renewable, and the resistor is made up of Ward Leonard enameled units. The panel is mounted in an entirely waterproof enclosing case, and before shipment a test of the case is made by placing it and the controller within under water for 24 hours to see if there is any leakage. Although built to Government specifications, the apparatus is applicable in places where its waterproof features would be of advantage. Needless to state, Government specifications are very rigid so that reliability is one of the features of the controller.

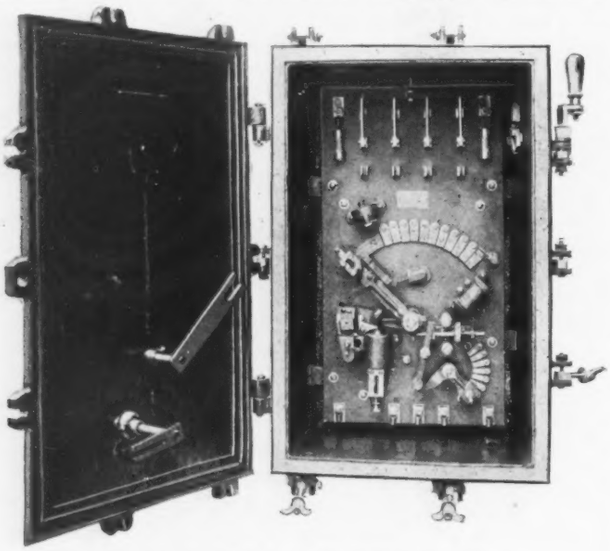
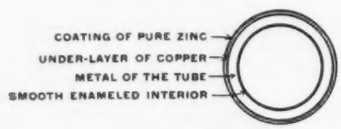


Fig. 1—Ammunition Hoist Controller, Open.

Fig. 2—Ammunition Hoist Controller, Closed.

ELECTRO-GALVANIZED RIGID CONDUIT.

The American Circular Loom Company, of Boston, Mass., has brought out a copper-plated rigid conduit for electric wiring with exterior coating of zinc and smooth enameled interior. The conduit, which is known as "Xduct," is a steel tube which has received first an electro-deposited layer of copper and then on top of the copper an electro-deposited coating of zinc. It is furnished in 10-ft. lengths, threaded both ends, with coupling. The layer of copper is even and continuous and forms an impervious covering for resisting corrosion even should the zinc coating be entirely removed. The copper coating also makes practical the preliminary plating of the tube in a definitely alkaline medium and insures uniform surface resistance while the zinc is being deposited. In coating the conduit with zinc there is no possibility of the presence of an alloy, since the zinc is deposited on copper and not on iron. The primary reason for applying the zinc to the tube is to prevent corrosion. The conduit can be used to advantage with concrete, as the exterior surface being smooth and clean the concrete mixture wets it throughout its length and subsequently bonds with it. The formation of pockets in which corrosive elements might accumulate is thereby avoided. The interior of the tube has a lining of alkali-and-acid-resisting enamel and is free from blisters, burrs or other obstructions; presenting a smooth and glossy surface to facilitate the insertion of wires and their ready withdrawal. The tube itself is made of mild steel and bends easily without danger of fracture. It is, of course, thoroughly cleaned before being placed in the plating bath and the threads being zinc coated save labor of rethreading and provide good contact at every joint. The conduit embodies the suggestion made at the last meeting of the National Board of Fire Underwriters that fittings have conductive coatings in order to secure better electrical contact at all points throughout the conduit system.

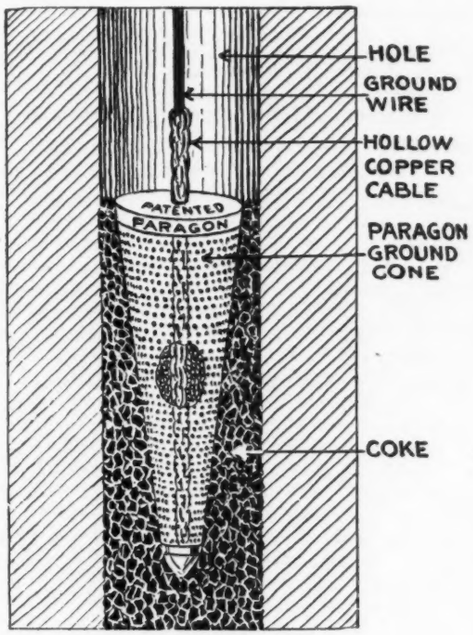


Cross Section of Conduit.

GROUND CONE.

It is often difficult to obtain a satisfactory "ground," and the grounding device illustrated herewith has been designed on common-sense principles with the idea of making an appliance that will meet all the requirements demanded of it. The accompanying illustration shows the cone placed in position in the ground. The cone is made of pure sheet copper, perforated with 75 openings to the square inch. It is filled with pea-sized charcoal, and a hollow copper cable runs through its entire length. This cable is soldered securely at the bottom, and extends about 3 in. or 4 in. above the top of the cone. The perforations not only allow the charcoal to absorb moisture, thus keeping the soil around the cone permanently damp, but they also furnish a much larger discharge area than the surface of the cone itself, taking into account not only the lateral surfaces, but the superficial area of each perforation. The sharp edges of the perforations act as discharge points, reducing the cone's electrostatic capacity to a minimum.

The hollow copper cable is furnished so that the ground wire may be run into it and slipped to the very bottom of the cone. A pull on the ground wire makes the cable lace itself tightly around the wire, on the same principle as the action of



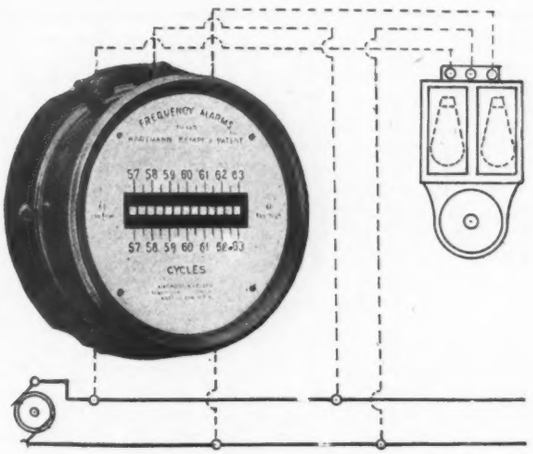
Ground Cone.

the ordinary cable "come-along." A little solder around the top of the cable keeps the wires together and insures perfect contact between the ground wire and the cone. The cone is tipped with a solid point of copper. The copper cable is 61,968 circ. mil in area. The cone can be buried to any depth by simply boring a hole with an ordinary post-hole auger and dropping the device in it.

It is recommended that charcoal or coke be tamped around the cone, as shown in the illustration, partly to protect it from possible chemical action of the soil, and partly to increase the moisture in the soil directly surrounding the cone. Two or more cones may be installed and connected together, if it is desired to obtain a greater grounding surface than that afforded by one cone. These cones are made in two sizes by the Paragon Sellers Company, 56 Fifth Avenue, Chicago. Each size is made in two gages of metal—a light gage for use with telephone and telegraph systems, and a heavier gage for grounding lighting or power systems.

FREQUENCY VARIATION ALARM.

The accompanying illustration shows a Hartmann & Braun standard, resonance type, frequency meter, within whose case is mounted a pair of relays which are likewise operated on the resonance principle. In the particular range which is shown, the normal frequency of the station is 60 cycles, and the two relays are adjusted one to operate at 59 cycles and the other at 61 cycles. With the wiring connections, as indicated by the dotted lines, a combination optic and acoustic alarm is operated whenever these limits are exceeded. The optical alarm consists of lamps behind differently colored glass screens, so that the attendant can tell at a glance whether the trouble is due to excessive speed or to insufficient speed. The operation of the frequency indicating reeds themselves is not interfered with by the presence of the relays, so that the instrument serves the same indicating purpose as does the ordinary model. Apparatus is supplied to indicate at one cycle above and one cycle below normal for 40-cycle and 60-cycle apparatus, and at ½ cycle below and ½ cycle above for 25-cycle apparatus. The standard finish of the instruments is dead black. The diameter of the case is about 9 in. In addition to the combination of indicator and alarm, separate relays of the resonance type are made for various purposes. One use of the relays is to protect alternators when these tend to race; for under such condition the frequency

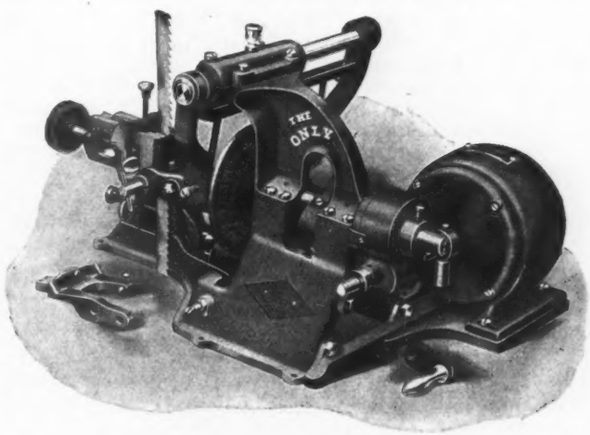


Frequency Variation Alarm and Connections.

rises, of course, putting the relay into operation. By the use of auxiliary apparatus the machine can be shut down before damaging itself. Machado & Roller, New York City, are the United States agents for the apparatus.

MOTOR-DRIVEN MACHINE FOR FILING AND SETTING BAND SAWS.

The accompanying illustration shows a machine for filing and setting band saws which requires only 16 in. by 22 in. of bench space. The saw hangs from a peg overhead and passes through the machine vertically, and it is claimed that the machine feeds the finished tooth away from the file, a feature that insures a uniform size and shape of tooth. The belt carriage possesses a positive motion, and cannot file deeper in brazes or other soft spots. The regular slim taper or taper files are employed, but machine files may be used if preferred. All the working parts are made of tempered tool steel and are interchangeable. The machines are made with belt drive, but are also built with motors, as shown in the engraving. A porcelain



Machine for Filing and Setting Band Saws.

plug and length of cord are part of the outfit, making it easy to attach it to any lamp socket. The motors are of the "Standard" type built by the Robbins & Myers Company, of Springfield, Ohio, and are of sufficient size to drive the machine under all conditions. The machine itself is built in three sizes to accommodate saws from 1/16 in. to 4½ in. wide, and is manufactured by the Black Diamond Saw & Machine Works, Natick, Mass.

Industrial and Commercial News

The Week in Trade.

RETAIL trade reports from the western section of the country were a trifle better last week than they have been since the beginning of the summer. Some increase in activity had been brought about by clearance sales and by more favorable weather. In spite of this betterment, however, the volume of distribution is not up to expectations and is far below the same period last year. Wholesale trade is unusually quiet even for midsummer. Although there are a fair number of buyers in the central markets, the orders placed are extremely conservative. There is a general disposition to wait a more definite knowledge of the crop situation and to make only very limited purchases at the present time. In many lines of industry there are midsummer shut-downs for repairs and overhaulings. This is especially noticeable in the iron and steel industry, where, in many instances, the prices at which business is being taken are not sufficiently attractive to engender any unusual activity. Pig iron has again been reduced in price and many of the furnaces have gone out of blast. Iron statistics for July 1 show a drop of 15 per cent in production as compared with February. The textile manufacturers are still curtailing output, and prices are more or less demoralized. The six months failure report as prepared by *Bradstreet's* is fairly encouraging. It shows a reduction of 3 per cent in the number of failures from 1909 and 23 per cent from 1908. Liabilities are heavier than they were during the first six months of 1909, but this was caused by two or three large suspensions. Collections last week showed the effect of the inactivity of retail trade and payments were reported as only fair. The disturbance in the security market was also responsible, in a measure, for this condition. Failures for the week, which ended July 7, as reported by *Bradstreet's*, were 172 against 196 the previous week, 182 in the same week of 1909, 246 in 1908, 185 in 1907, and 143 in 1906.

The Copper Market.

JUNE figures furnished by the Copper Producers' Association did very little to help along the condition of the copper market. While they showed that there had been quite an increase in the exports during June, and that the total delivery had been 119,259,144 lb., they also showed that the daily rate of production for the month was 4,240,636 lb. This is the heaviest rate of production ever known, and is little short of startling. The rate for May was 3,975,563 lb. If the present daily rate continues, and there is no reason to believe that it will decline, the total production for the month of June will be in the neighborhood of 131,500,000. While there has been some increase in the consumption of American copper in Europe, it is estimated that it does not average more than 40,000,000 lb. per month. It is also figured that the total consumption requirements of American copper, including domestic melting, will not be more than 100,000,000 lb. per month. It is, therefore, very evident that large quantities of copper are being produced which are not being melted. Whether these surplus stocks are being carried by speculators, by the producers or in the warehouses of actual consumers makes little difference so long as they are in existence. The figures of the June report of the Copper Producers Association were: Production, 127,219,188 lb.; deliveries, 119,259,144 lb.; and stocks on hand at the end of the month, 168,386,017 lb. This is an increase of 7,961,000 lb. during the month. The exports for June were 65,895,948 lb. and the domestic takings 53,363,196 lb. The imports continue to be unusually large. Exports for the month, including July 11, have been 6162 tons. The daily call on the metal exchange July 11 quoted standard copper as per the accompanying table.

Standard Copper.	Bid.	Asked.	Settling price.
Spot	11.50	12.00	.....
July	11.50	12.00	11.75
August	11.50	12.00	11.75
September	11.62½	12.00	11.80
October	11.75	11.90	11.82½

The London market July 12 was as follows:

	Noon. £ s. d.	Close. £ s. d.
Standard copper, spot	53 15 9	53 8 9
Standard copper, futures	54 8 9	54 1 3

Extreme fluctuations for this year:

	Highest.	Lowest.
Standard	13.50c	12.05c
London, spot	£62 0 0	£54 2 6
London, futures	65 18 9	54 17 6
Best selected	65 10 0	59 0 0

Industrial and Commercial Notes.

Acheson Plant Extensions.—The International Acheson Graphite Company, of Niagara Falls, N. Y., has arranged to erect an addition to its works on the lands of the Niagara Falls Power Company in that city. The addition will be in the nature of a furnace room, which will afford capacity for 10 or 12 new furnaces. The buildings will be of brick and steel construction and erected to the west of its present works, where there is ample room for still further enlargement. The additional furnaces will make possible a very large increase in the output of graphite in the form of electrodes for electrochemical, metallurgical and electrical purposes, powdered graphite for dry-cell filler, paint pigment, powder glazing, lead pencils, firearms lubrication, general lubrication, electrotypers' molding and polishing leads, etc. The Acheson Oildag Company has purchased recently a factory site of 30 acres at Port Huron, Mich., and will erect there a large plant. Port Huron was selected as the site because of its comparatively pure water and excellent shipping facilities. On July 1 the Acheson Oildag Company reduced the selling price of Oildag to approximately 60 per cent of that previously quoted, thereby bringing it down to a price, when bought in quantity, of considerably less per gallon than that of the oil with which it is mixed. The presence of the deflocculated graphite in the oil is claimed to make each gallon equal to from two gallons to four gallons of plain oil.

General Electric Company's Business.—An official of the General Electric Company states that the orders taken during the first six months of 1910 are at an annual rate of between $70,000,000 and $71,000,000. The business for June was better than it was for May, and the total for the six months was slightly in excess of $35,000,000. Business for 1909 (11 months), as shown in our issue of Jan. 6, was about $55,000,000. The company is now employing almost as large a number of men as at any time in its history. Its aggregate number at the various plants is in the neighborhood of 30,000. As a rule, the majority of the business is for the smaller classes of apparatus. There has been a particular activity in the line of street-car motors and equipment. There has also been a very large development in the manufacture of household and other similar appliances.

Commercial Cable Company.—A representative of the Commercial Cable Company says that the completion of the new submarine cable between Waterville, Ireland, and Weston-super-Mare, England, which was accomplished last week, will add materially to the transatlantic cable service. This makes three cable lines between these points. The new cable which the Commercial Cable Company has planned to build by way of Newfoundland is being held up pending the settlement of the difficulties with the Newfoundland government. The representative above referred to believes that this matter will shortly be settled, and says that as soon as it is the new cable will be laid and another transatlantic cable line opened.

C. W. Hunt Slope Business.—Arrangements have been made by the C. W. Hunt Company, New York, builders of coal-handling, conveying and hoisting machinery, by which its business on the Pacific Coast will be handled by the San Francisco Bridge Company, with offices at 865 Monadnock Building, San Francisco. The company has just completed a naval coaling station in San Francisco Bay for the government.

Chattanooga & Tennessee River Power Company.—A contract has been made by the Chattanooga & Tennessee River Power Company with Jacobs & Davies, of 30 Church Street, New York, for the completion of the hydroelectric plant at Hale's Bar, on the Tennessee River. About 50 per cent of the work on this plant has already been done. When completed, it is expected to develop 50,000 hp.

Great Eastern Telephone Company.—Mandamus proceedings were commenced last week in the Supreme Court of New York City by the New York Electric Lines Company against the Empire City Subway Company, Ltd., praying for a peremptory writ to compel the Subway company to give space to the wires of the Electric Lines company in its conduits. The New York Electric Lines Company is a wire-leasing concern holding a perpetual franchise dated 1883. It is controlled by the same interests that organized and own the Great Eastern Telephone Company, and its wires, if they are permitted in the conduits, will be leased to the Great Eastern Telephone Company for the operation of an independent system in New York City. The present demand for space covers only about 30,000 ft., and is intended to supply the initial exchange of the Great Eastern company, which will be in the financial district of lower Manhattan. A decision has already been rendered by the Court of Appeals of New York, practically establishing the right of the Electric Lines company to space in the conduits. Speaking of this enterprise, D. A. Reynolds, president of the Great Eastern company, said: "After having had our rights established in the conduits, we made a tender, on June 7, of $5,000 to the Empire City company to pay for space in the conduits. This tender was declined and on that account we have brought the mandamus suit. We hope to have the matter definitely settled by the highest court in the State within the next three months, and as soon as it is, if settled in our favor, we will begin placing our wires. The Great Eastern Telephone Company was organized with an authorized capital of $1,000,000, but since then the stockholders have voted to increase this amount to $50,000,000. Only a few shares of this stock, however, have been issued, the balance being held until the rights of our affiliated wire-leasing company are established. The Great Eastern company has contracts in the Wall Street section for 107,000 telephones ready to be installed as soon as it is prepared to operate. It controls the State Line Company operating in Columbia, Dutchess and Westchester counties, which will give it a long-distance outlet to the North. It also controls the Coast Line Telephone Company and the Hudson & Middlesex Telephone & Telegraph Company, in New Jersey. This will give it long-distance connections to the West. We claim that we will be able to furnish a telephone service at about 48 per cent of the charge now made in New York City."

Oil Engine Industry.—There is a very satisfactory increase in the oil engine industry in connection with electric generation, according to statements made by Mietz & Weiss, manufacturers, of 128-138 Mott Street, New York. C. W. Weiss says that there is a constantly growing demand for this class of engine for small central stations, for farm plants, for isolated plants in stores and residences, and for small pumping stations. The company has also taken quite a large number of orders from the government for oil engines to be used in connection with wireless equipment on battleships. These orders have for the most part been delivered to the Brooklyn Navy Yard, and the engines thoroughly tested there before being placed on the ships. As a rule these engines run from 7 to 12 hp. Mr. Weiss says that the economy of operation of the oil engine is recommending it to a great many people who never before have understood its merits. Among the recent sales which this firm has made are: One 100-hp and two 25-hp engines to the Andover (Mass.) Water Company; one 100-hp to the Gregory (S. D.) Light & Power Company; one 50-hp to the Ireton (Iowa) Electric Light & Power Company; one 80-hp to the Huron (S. Dak.) Milling Company, to generate energy for driving individual mill motors; one 35-hp to the Bridgewater (S. Dak.) Electric Power Company; one 50-hp. to the Leaksville (N. C.) Light & Power Company; one 50-hp to the Faulkton (S. Dak.) Light, Heat & Power Company; one 50-hp to the Sheldon (Iowa) Electric Station, and two 80-hp to the Holmes Machine Company, Sparta, Mich., to generate energy for individual machine motors. Mr. Weiss says that the economy shown in a small water works plant in New England, where oil engines have been used for several years, has induced a number of towns in that section to take up the matter of using this class of engine. The initial cost of these engines is, as a rule, more than that of gas engines, but the manufacturers claim that the economy in operation is sufficient to offset any additional cost.

Plans of the New Illinois Valley Company.—The first step in the development of the system of the new Illinois Valley Gas & Electric Company, of Streator, Ill., the formation of which was mentioned in these columns June 16, will probably be the construction of a 33,000-volt transmission line connecting Joliet, Wilmington, Dwight, Streator and intermediate towns. The new company will be closely affiliated with the Economy Light & Power Company, of Joliet, Samuel Insull, of Chicago, being president of both. The Economy company has a water-power plant on the Des Plaines River at Joliet, and electrical energy from this plant will be utilized. From the principal transmission line mentioned branch lines will be constructed to Coal City and other adjoining towns on the Santa Fé Railroad. There will also be two other 33,000-volt transmission lines, one connecting Joliet and Ottawa and the intermediate towns, and another running from Ottawa to Streator. The aggregate length of these 33,000-volt lines will be 128 miles. The branch lines, operating at 11,000 volts and 4000 volts, will be 27¾ miles long. The plans involve the erection of a 10,000-hp auxiliary steam station in Streator. Plans are under way for the erection of five substations, which will be located at Wilmington, Braidwood, Dwight, Gardner and Odell, through each of which the 33,000-volt line will be looped and transformers installed, stepping down to 2300-4000 volts. As soon as the transmission line has been constructed it is planned to transfer the load of the least economical plants to those showing better economy, and this weeding-out process will ultimately result in the concentration of the generation of the entire system in not more than two or three thoroughly modern steam and water-power plants.

American "Z" Electric Lamp Company.—The American "Z" Electric Lamp Company, 149 Broadway, New York, has printed in the newspapers an open letter addressed to the president of the International Tungsten Lamp Company, in which a protest is made against a statement that a connection exists between these two companies. In the letter it is stated that a contract was made March 20, 1910, between the America "Z" Electric Lamp Company and A. J. Clark, of Detroit, Mich., granting the latter the sole right to manufacture for the company metallic filament lamps under the American license for the use of the Herman Zerning processes and inventions, and notice is given that the transfer of this contract to the International Tungsten Lamp Company is not approved and will be contested. Among the grounds given for this position are that the name of the company is objectionable; that as only about $50,000 is needed to begin manufacturing, the proposed issue of $5,000,000 in stock is a gross overcapitalization; and that making the shares of a manufacturing company of this nature of a par value of $1 per share is objectionable.

Electrical Construction.—Among the items printed under Construction News in our present issue are announcements of proposed new plants or considerable extensions of present plants at Pittsburg, Pa.; Browntown, Wis.; Streator, Ill.; Appleton, Wis.; Ingersoll, Ont., Can.; Auburn, Cal.; Livonia, N. Y.; Minneapolis, Minn.; Princeton, Ind.; Wallace, N. C.; Vancouver, B. C., Can.; Fort Missoula, Mont.; York Springs, Pa.; Wilson, Kan.; San Francisco, Cal.; Fresno, Cal.; New Hamburg, Ont., Can.; Moose Jaw, Sask., Can.; Rapid City, S. D.; Abbeville, Ala.; Tampa, Fla.; Sylvania, Ga.; Osage, Okla.; Hudson, Ohio; Wheatland, Wyo.; Foraker, Okla.; San Augustine, Tex., and Goshen, Ind.

New Steam-Reserve Plant for Goshen, Ind.—The Hawks Electric Company, which does the central-station business of Goshen, Ind., is about to build a new steam generating plant. The company produces its principal supply of electricity by a 300-kw hydroelectric plant on the Elkhart River. It also has a steam-reserve plant in a flour mill. The new plant will be erected as an addition to the water-power plant and will take the place of the old reserve plant. It will contain two water-tube boilers and a 500-kw turbo-generator producing 2300-volt, 3-phase, alternating current. F. J. Postel & Company, of Chicago, are the designing engineers for the Hawks Electric Company.

Consolidated Traction Company's Rehabilitation in Chicago.—Plans for the absorption of the Consolidated Traction Company, of Chicago, by the Chicago Railways Company appear to be proceeding smoothly. Under foreclosure proceedings it is thought that a decree will be entered on or about July 15, allowing 30 days thereafter for the sale of the properties to the Chicago Railways Company. No doubt an ordinance will be introduced in the City Council of Chicago providing for the rehabilitation of the Consolidated company's physical property, which is badly needed.

Tunnel Service to Long Island in September.—Ralph Peters, president of the Long Island Railroad, announced last week that the opening of through service between Long Island points and the new Pennsylvania Railroad terminal in Manhattan had been postponed until Sept. 8, when the fall train schedule goes into effect. The tracks and platforms of the station are all ready for service now, but the fixtures have not yet all been placed and there is a great amount of cleaning up and instructing station employees to be done. When the new service is commenced through electric trains will be run from the station to Far Rockaway, Long Beach, Hempstead and Jamaica. Enough of these trains will stop at Winfield Junction to connect with the trains from the Port Washington and College Point branches. The railroad has been somewhat delayed by the failure to get deliveries of the new steel cars ordered more than a year ago, but it is now claimed that the road will have ample equipment by Sept. 1 for all purposes.

General Electric's Copper Mine.—An official of the Bully Hill Copper Mining & Smelting Company, which is owned by the General Electric Company and which has recently been closed down, as was stated in the issue of June 23, has explained the reason for the shut-down. It seems that the government authorities, according to this official, ordered the smelter to eliminate the smoke nuisance. While the official says that this is the only complaint ever made on this score, it was thought best to suspend operations rather than go to the expense of making changes that would do away with the fumes of the smelter. "Our company," he said, "is not large enough to justify this expense, and we can well afford, with copper at the present price, to discontinue mining operations."

Storage Cars for Third Avenue Railroad Company.—The Third Avenue Railroad Company has ordered thirty storage battery cars for use on some of its small subsidiary lines, which have heretofore been operated by horse cars. This course was adopted after quite a number of months of experimentation with both storage battery and gasoline cars. The batteries for equipping these cars were ordered from the Gould Storage Battery Company, and the motors will be furnished by the General Electric Company. The Third Avenue company will build the cars in its shops.

Financial.

The Week in Wall Street.

ALTHOUGH the condition of the market in Wall Street was extremely irregular last week, and many stocks made new low records for the year, the tone at the end of the week was stronger than at the beginning and prices were about the same on most of the active issues. In the opinion of many, the low points of last week were about the culmination of the long decline that has been affecting the market since the early spring. The average price of the 20 active railroad stocks, which are usually taken as a barometer for the purpose of comparison, reached 110.63 at the low point last week. The average on the first day of the year of these same stocks was 130.41. This comparison probably gives as lucid an idea of the decline that has taken place in securities as any that can be offered. For several days there was heavy liquidation, and all efforts of the bulls to support the market seemed to be futile. It is thought that the majority of the shorts covered during this period, and the decline in prices certainly brought into the market a considerable amount of investment buying, a thing that had been absent for many, many weeks. This buying, together with the fact that toward the end of the week there was a break in sterling exchange and a promise that gold imports would soon be inaugurated, caused a strengthening in prices and a vast improvement in tone. The ill reports from the spring wheat crop, which were used as a club to hammer the market, have apparently lost their effect. The condition of other crops is so satisfactory that a reduction in the yield of wheat is not likely to prove disastrous. The money market has continued remarkably easy under the stress of demoralized prices for securities. While the bank statement was not as satisfactory as had been predicted, there was still about it nothing to alarm investors. Quotations for money July 11 were: Call, 2½@3 per cent; 90 days, 4 per cent. The quotations in the table are those of the close July 11.

NEW YORK

	July 1.	July 11	Shares sold.		July 1.	July 11	Shares sold.
All.-Ch.	8½*	8½*	100	Int.-Met., pfd	51⅜	51⅜	16,345
All.-Ch., pfd.	30¼	30*	200	Mackay Cos.	84½	85¾*	400
Amal. Cop.	60⅝	57½	194,025	Mackay C., pf	73*	75*	125
Am. D. T.	20½*	20½*	——	Man. Elev.	125	125½*	830
Am. Loc.	40½	40½	4,950	Met. St. Ry.	15*	15*	——
Am. Loc., pfd.	107*	107	——	N.Y.&N.J.Tel.	139½*	139¼*	——
Am. Tel. & C.	75*	71½	100	Steel, com.	72⅛	70⅝	753,150
Am. T. & T.	132½	132¾	6,250	Steel, pfd.	115½	116	11,000
B. R. T.	74¼	76¾	28,975	U. U. T.	62¾	62⅛	2,150
Gen. Elec.	141	141½	1,850	West'h., com.	61	61½	2,600
Int.-Met.	17¾	18¼	12,300	West'h., pfd.	115*	115*	——

PHILADELPHIA.

	July 1.	July 11.		July 1.	July 11.
Am. Rys.	43*	42½	Phila. Elec.	14⅜	14¾
Elec. Co. of A.	11⅜	11⅝*	Phila. R. T.	18½	19
Elec. St. B'ty.	49	49¾	Phila. Trac.	84½*	84¼*
E. S. B'ty, pfd.	30*	30*	Union Trac.	45	45½

CHICAGO.

	July 1.	July 11.		July 1.	July 11.
Chi. City Ry.	180*	180	Chi. Tel. Co.	117*	118
Chi. Rs., Ser. 1.	75*	70	Met. Tel. Co.	22*	20*
Chi. Rs., Ser. 2.	16½	16	Met. El., pfd.	70*	61½*
Com. Edison	112	112	Nat'l Carbon	120	120*
Chi. Subways	2⅛	2¼*	Nat'l Car., pfd.	118*	118*

BOSTON.

	July 1.	July 11.		July 1.	July 11.
Am. T. & T.	132½	132¾	Mex. Tel.	5½*	5*
Cum. Tel.	142*	142*	Mex. Tel., pfd.	6½*	6½*
Edison E. Ill.	252	255*	N. E. Tel.	133¼	134*
Gen. Elec.	140	142	W. T. & T.	15¼*	15*
Mass. E. Ry.	14¾	15¾*	W. T. & T., pfd.	87*	87*
Mass. E. Ry., pfd.	76	75*			

* Last price quoted.
Shares sold for four days, July 5 to July 9.

Financial Notes.

Sierra & San Francisco Power Company.—It is said that before the end of the month the United Railways Investment Company will probably have acquired through a subsidiary company the delivery of $20,000,000 of common stock of the Sierra & San Francisco Power Company. This company has recently authorized an issue of $6,500,000 of bonds, to be used for taking over the steam-power system of the United Railroads of San Francisco. A contract has been made between the railroad company and the power company for 44 years. It is said that $1,000,000 will be expended at once on the distribution system in San Francisco. The power company will produce approximately 78,000 hp, half of which will be used by the traction lines in San Francisco, the other half to be sold in the city and in the smaller towns through which the distribution lines pass.

Mexican Telephone & Telegraph Company.—Announcement has been made in the city of Mexico that on Jan. 1, 1911, the exchange service of the Mexican Telephone & Telegraph Company in that city will be doubled to meet the rapidly increasing business. The company has now under construction a new central office at Calle de Ezequiel Montes to carry a new switchboard of the same capacity as the old switchboard now in service. When the company installed the present switchboard, in the San Agustin exchange, three years ago, it was thought that it was large enough to handle all of the business for at least 10 years, but the increase of telephones within the three years has made this doubling of capacity necessary.

Mexican Light & Power Company.—The annual report of the Mexican Light & Power Company, which is largely owned in Montreal, says that while the construction work is not yet complete, and ample water power has not yet been secured, the gross earnings for the year amounted to $3,014,325, as compared with $2,938,474 the previous year. A 7 per cent dividend was declared upon the preferred stock and a 4 per cent dividend upon the common stock. During the year extraordinary expenditures were incurred in connection with the steam plant, which had to be operated on account of the noncompletion of the reservoirs.

Denver & Inter-Mountain Railroad Company.—Interests identified with the Denver City Tramway Company have secured control of the Denver & Inter-Mountain Railroad Company. This road has 22 miles of track and connects Denver and Golden. The new owners will practically re-equip the line and will probably spend $100,000 in that direction.

Washington-Virginia Railway Company.—A charter has been issued by the State Corporation Commission of Virginia to the Washington-Virginia Railway Company. The company has an authorized capitalization of $1,000,000, and is empowered to construct and operate an electric road from Vienna to Bluemont, Va.

Pioneer Telephone Company.—The Pioneer Telephone Company, Oklahoma City, has purchased the properties of the Leger & Chickasha Telephone Company and the Mangum & Quanah Telephone Company. The price paid for the two was $90,000. The two systems include five exchanges and 17 toll lines.

American Light & Traction Company.—The earnings of the American Light & Traction Company, both gross and net, continue to show improvement. The gain in the former in May amounted to more than 22.75 per cent, and in the net the gain amounted to 23.75 per cent. For the five months which ended May 31, the gross improvement was better than 15.5 per cent. The officials of the company state that the weekly returns now coming to hand indicate a steady improvement in business. It is confidently expected that 1910 will be the largest year in the company's history as regards the volume of business handled and the revenues derived therefrom. The earnings of the company for the 12 months which ended March 31 last show an amount available for dividends on the common stock equal to 26.02 per cent. The company has already declared several extra dividends, and this policy will probably continue. The directors met last week and declared a quarterly dividend of 2½ per cent on the common stock payable Aug. 1, and an extra dividend of 2½ per cent payable Aug. 15. The regular quarterly dividend of 1½ per cent on the preferred stock was also declared.

Telephone Consolidations.—The New York Telephone Company certified to the Secretary of State at Albany last week that it had absorbed the New York & Pennsylvania Telephone & Telegraph Company. This company was capitalized at $1,000,000, and operated telephones in the southern tier of counties of New York State and some of the northern counties of Pennsylvania. This absorption is in line with several previous mergers and in keeping with the policy of the American Telephone & Telegraph Company to consolidate its operations into large corporations, rather than to hold a number of small companies. In the same general policy, the New England Telephone & Telegraph Company, a subsidiary of the American, last week purchased the People's Telephone Company, operating in Exeter, Hampton and neighboring New Hampshire towns.

Elevated Merger in Chicago.—Henry A. Blair, the New York financier, who is engineering the Chicago elevated merger, says that negotiations will again be taken up this week and that everything is now sufficiently advanced for him to feel assured of the success of the plan. The condition of the securities market in Wall Street had caused the syndicate, represented by Mr. Blair, to pause, but it is now believed that there will be no difficulty in raising all the funds necessary to carry out the project. The temporary check in the deal caused some sharp declines in the prices of elevated stocks on the Chicago Exchange last week.

Pacific Power & Light Company.—The name of the newly incorporated company, subsidiary to the American Power & Light Company, which will control the properties recently collected by H. M. Byllesby & Company, of Chicago, in southeastern Washington and northern Idaho, is the Pacific Power & Light Company. Full details of the deals by which these properties were consolidated were published May 19 and June 16. The new company will have its headquarters in Portland, Ore., and will be capitalized at $7,500,000.

Philadelphia Rapid Transit Company.—The receipts of the Philadelphia Rapid Transit Company for the fiscal year which ended June 30 will be shown to be about $325,000 less than those of the preceding year. According to a statement made by one of the directors, it is estimated that the deficit for the year will be upwards of $600,000.

Hackensack-Paterson-Englewood Electric Railway Sold.—The Public Service Corporation of New Jersey has acquired a controlling interest in the New Jersey & Hudson River Railway Company, consisting of several lines connecting Paterson, Hackensack, Englewood and adjacent cities, with a terminal at Edgewater on the Hudson River, where the power house is situated. The system has 48 miles of track, and includes the Fort Lee ferry. The property was developed by Ford, Bacon & Davis, from whom the control was purchased.

Interborough Sells Notes.—The Interborough-Metropolitan Company, which is the majority stockholder of the Metropolitan Securities Company, has sold $4,000,000 of 5-year 6 per cent notes at par, in order to provide the necessary cash for the payment of its share of the $5,500,000 settlement of the litigation instituted by the receiver of the New York City Railway Company. It is understood that ten directors of the Metropolitan Securities Company contributed the other $1,500,000 necessary.

Berwyn & Laurel Electric Railroad Company.—The United States Court of Baltimore last week appointed Charles F. Gladfelter receiver for the Berwyn & Laurel Electric Railroad Company. This action was brought on account of the failure to pay the $239,621 due on the 5 per cent gold bonds. A foreclosure sale will probably be ordered. The company owns no rolling stock of its own, being operated by the City & Suburban Railway Company, of Washington.

Chicago Edison Bond Redemption.—The Commonwealth Edison Company, of Chicago, has called for redemption the $5,335,000, 5 per cent bonds of the Chicago Edison Company, dated July 1, 1896. These bonds will be redeemed April 1, 1911, through the Merchants' Loan & Trust Company, of Chicago. The Commonwealth company offers to exchange its 5 per cent mortgage bonds for the Chicago Edison bonds at any time prior to Aug. 15, 1910.

DIVIDENDS.

American Light & Traction Company, quarterly, preferred, 1½ per cent; common, quarterly, 2½ per cent., both payable July 16; common, extra 2½ per cent., payable in common stock Aug. 15.

Brooklyn City Railroad Company, quarterly, 2 per cent., payable July 15.

Electric Company of America, semi-annual, 3½ per cent., payable Aug. 3.

Minneapolis General Electric Company, common, quarterly, 1¾ per cent; preferred, semi-annual, 3 per cent, both payable Aug. 1.

National Carbon Company, quarterly, common, 1½ per cent, payable July 15.

Railway & Light Securities Company, of Boston, preferred, semi-annual, 3 per cent; semi-annual, common, 2 per cent, both payable Aug. 1.

Rio de Janeiro Tramway Light & Power Company, quarterly, 1¼ per cent, payable July 15.

San Diego (Cal.) Consolidated Gas & Electric Company, preferred, quarterly, 1¾ per cent, payable July 15.

Union Traction Company of Indiana, semi-annual, 1 per cent, payable July 9.

United Gas & Electric Company of New York, semi-annual, preferred, 2½ per cent, payable July 15.

United States Rubber Company, quarterly, first preferred, 2 per cent; second preferred, 1½ per cent, payable July 30.

United Traction Company, Pittsburgh, semi-annual, preferred, 2½ per cent, payable July 20.

J. G. White & Company, quarterly, preferred, 1½ per cent. payable Aug. 1.

REPORTS OF EARNINGS.

	Gross earnings.	Expenses.	Net earnings.	Charges.	Surplus.
Birmingham (Ala.) Railway, Light & Power Company:					
May, 1910	$218,575	$129,564	$89,011	$45,498	$43,513
May, 1909	184,825	117,190	67,635	44,798	22,637
Cumberland Telephone & Telegraph Company:					
May, 1910	570,195	322,540	247,655	47 717	199,938
May, 1909	524,954	297,454	227,500	41,110	186,390
Detroit United Railway Company:					
May, 1910	795,380	476,300	319,080	163,368	167,908
May, 1909	664,507	389,179	275,328	154,932	133,065
Ft. Wayne & Wabash Valley Traction Company:					
May, 1910	122,343	71,294	51,049	44,912	6,137
May, 1909	111,702	66,890	44,812	43,097	1,715
Mexican Light & Power Company:					
Year 1909	3,014,325	1,126,235	1,889,090	1,776,594	111,496
Year 1908	2,938,474	1,080,570	1,857,904	1,665,102	192,801
Mexican Telephone & Telegraph Company:					
May, 1910	45,988	21,853	24,135	.....	.....
May, 1909	37,444	17,589	19,855	.....	.....
Norfolk & Portsmouth Traction Company:					
May, 1910	160,492	93,510	66,982	.....	.....
May, 1909	151,599	92,659	58,940	.....	.....
Portland (Me.) Electric Company:					
May, 1910	28,648	10,317	18,331	.....	.....
May, 1909	25,386	9,837	15,549	.....	.....

General News

Construction News.

ABBEVILLE, ALA.—The Abbe Light & Power Company, recently incorporated, with a capital stock of $60,000, is reported to be contemplating the construction of an electric power plant to generate 1000 hp for transmission. It is understood that bids for construction will be called for in the near future. James R. Hall, of Columbus, Ga., is engineer in charge.

BESSEMER, ALA.—The City Council has granted the Birmingham Water & Light Company, of Birmingham, Ala., a franchise for an electric light plant and water-works system in Bessemer.

BIRMINGHAM, ALA.—The Birmingham Rail & Locomotive Works, of Birmingham, Ala., has recently placed an order for electrical machinery and equipment for its new plant amounting to about $25,000. Haskins Williams is president.

EUFAULA, ALA.—It is reported that the Eufaula Gas, Electric Light & Power Company has applied to the City Council for permission to remove its power house to a more desirable location on Union Street. If granted permission to remove the plant the company agrees to enlarge the plant and purchase additional machinery.

FORT MORGAN, ALA.—The contract for installing the electric lighting system at Fort Morgan, Ala., was awarded to the Babcock & Wilcox Company, of New Orleans, La., for $6,994.

MOBILE, ALA.—The Alabama Canning Company is reported to be contemplating the installation of an electric light plant.

MONTGOMERY, ALA.—Mayor Gaston has asked the City Council to pass an ordinance requiring all overhead wires in the business section of the city to be placed underground.

MONTGOMERY, ALA.—It is reported that the City Council has authorized Mayor Gaston to enter into a contract with the Montgomery Light & Water Company to supply electricity to operate the water works system.

SELMA, ALA.—The Selma Street & Suburban Railway Company is reported to be contemplating extending its railway to Summerfield, work on which will commence at once.

THOMASTON, ALA.—Plans have been prepared for the erection of a telephone system in Thomaston, with branch lines to Prentice, Consul, McKinley and Hugo. It is understood that work on construction of the line will begin in the near future.

THORSBY, ALA.—The Northrup Manufacturing & Supply Company, of Thorsby, Ala., is reported to be in the market for a 20-hp gas engine to operate an electric generator; also for wire, generator with sufficient output to supply 200 lamps, 16-cp lamps and tungsten lamps. C. E. Northrup is president of the company.

IMBODEN, ARK.—The property of the Imboden Power & Development Company, which was recently sold at a receiver's sale to the Peoples' National Bank, has changed hands again, having been purchased by Mrs. J. Nash, of Jonesboro, Ark. It is understood that the new owner will make extensive improvements to the plant and service.

LESLIE, ARK.—J. W. Vaughn and James F. Kiser, of Leslie, have been granted a franchise by the City Council to construct and operate an electric light plant and water works system in Leslie.

AUBURN, CAL.—The Bell Electric Company is reported to have notified the Board of City Trustees that it will make improvements to the street lighting system, at a cost of about $3,000. New lamps will be erected in all parts of the city which will be placed under the direction of the trustees.

FRESNO, CAL.—The property and holdings of the Fresno Traction Company have been taken over by the Southern Pacific Railroad Company. F. W. Webster has succeeded A. G. Wishon as general manager of the Company.

FRESNO, CAL.—It is reported that the Southern Pacific Railroad Company is contemplating the construction of an electric power plant to supply electricity for lighting the depot, yards and freight sheds. At present the service is furnished by the San Joaquin Light & Power Company, of Fresno, Cal.

GEYSERVILLE, CAL.—The Cloverdale Light & Power Company, of Cloverdale, Cal., is contemplating making improvements to its local service, including the installation of a regulator.

LOS ANGELES, CAL.—It is reported that the Central Oil Company, which has valuable holdings in Whittier field, is contemplating the installation of an electric light plant.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway Company is preparing to install a complete signal system at its terminals, contract for which has already been placed.

OROVILLE, CAL.—Notice of appropriation of 20,000 cu. in. of water has been filed in the office of the county recorder by Charles Swezy, of Sacramento, of which 10,000 cu. in. is to be taken from Mosquito Creek and 10,000 cu. in. from French Creek, to be used for irrigation and power purposes. The water will be taken from Mosquito Creek at a point one mile from its junction with French Creek. From French Creek the water will be taken at a point above the junction of the two streams. The water from Mosquito Creek will be diverted by means of a concrete dam 15 ft. high and 40 ft. wide. On French Creek it is proposed to build a dam 10 ft. high and 50 ft. wide.

PASADENA, CAL.—The citizens of the northwest section of the city have started a project for municipal ownership of street railways. An effort has been made to have the Pacific Electric Railway Company build a branch up Lincoln Avenue. The company demanded a 10-year franchise and a bonus of $45,000 to make the extension. It is estimated that the railway can be built for about $23,000. It is now proposed that the citizens of the northwest section raise the money to build the road and turn it over to the city to operate when completed. The City Council has not yet taken up the project.

REDDING, CAL.—The Sierra Nevada Power & Irrigation Company has filed three complaints in the superior court of Shasta County against the Central Pacific Railroad Company and others to condemn rights of way for a ditch and power line and to quiet title to riparian rights of land owners on Montgomery Creek, Hatchet Creek and Roaring Creek. The irrigation company was incorporated last April and has acquired water rights of 15,000 cu. in., 5000 cu. in. on each of the creeks mentioned. The three creeks run into Pit River, where the company proposes to construct its power house. The company is trying to secure the rights of way for flumes and ditches in order to bring the water of the three creeks together at the power house. George O. Perry and John J. Dailey are directors of the power company.

ROSEVILLE, CAL.—At an election held June 28 the citizens voted in favor of the proposition to issue $90,000 in bonds, the proceeds to be used for the installation of an electric light and power plant and sewer system.

SANTA ANA, CAL.—It is reported that the Chamber of Commerce has subscribed funds to install an electric light plant and to build houses for the miners at the coal mines in Orange County, located about three miles above Orange County Park.

SAN FRANCISCO, CAL.—The Board of Harbor Commissioners has awarded the contract for lighting the ferry building and the water front for a term of three years to the Mutual Electric Light Company at the rate of $1.25 per week for each arc lamp of 2000 cp, with all-night service, and electricity for incandescent lamps at 2¾ cents per kw-hour. Under the new contract the rate for arc lamps is 5 cents less per week and 19/100 of a cent less for incandescent service than under the previous contract.

SAN FRANCISCO, CAL.—The Sierra & San Francisco Power Company, which supplies electricity for operating the system of the United Railroads of San Francisco, has authorized an issue of $6,500,000 in bonds, the proceeds to be used for the purpose of enlarging its plant and extending its service. The company has purchased the entire power system of the United Railroads and has entered into a contract for a term of 44 years to supply the latter with energy to operate its railways. The Sierra & San Francisco Power Company proposes to expend $1,000,000 during the next three years for the construction of a distributing system in San Francisco and elsewhere. The district now served by the company includes the counties of San Mateo, Santa Clara, Alameda, San Joaquin, Tuolumne, Stanislaus and Calaveras. The principal power station of the company is located on the Stanislaus River, north of Sonora, the transmission line passing through Vallecito, Angels Camp, Copperapolis, Tracy, Mission, San Jose and thence to San Francisco. The company proposes to develop additional water rights on the Stanislaus River, which will more than double its present hydraulic capacity. The output of the auxiliary steam plant is to be increased from 12,500 hp. to 28,500 hp. next year.

SAN MIGUEL, CAL.—The Sunset Mining Company, which is mining coal at La Barranca, Sonora and San Miguel, is reported to be preparing plans to install a large electric power plant to furnish power for its mines and to supply surrounding mines and hamlets with electrical service.

NEDERLAND, COL.—The Wolf Tongue Mining Company has contracted with the Central Colorado Power Company to extend its transmission lines to the Wolf Tongue mill, which will be operated by electricity instead of steam power.

NEW HAVEN, CONN.—Preparations are being made by the United Illuminating Company to remove all wires from the old Green. It is proposed to erect ornamental iron lamp posts and to lay wires leading to them in underground conduits. The company is now laying underground conduits in Elm Street.

WASHINGTON, D. C.—Bids will be received by the Department of the Interior, Washington, D. C., until July 22 for the installation of two electric passenger elevators for the pension office building, Washington, D. C., in accordance with plans and specifications, copies of which can be obtained on application to the chief clerk of the department.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until July 19 for furnishing to the navy yards and naval stations the following supplies; Schedule 2612—F. o. b. 40 gun-elevating electrical equipments for vessels, Mare Island, Cal. Newport, R. I., Schedule 2651—Boiler stoker, etc. Portsmouth, N. H., Schedule 2672; 13 compressed air-driven hammers and two drilling machines. Brooklyn, N. Y., Schedule 2673—Two sets gasoline machinery. Applications for proposals should designate the schedule desired by number.

WASHINGTON, D. C.—David J. Braun Manufacturing Company, of Chicago, Ill., has been awarded the contract for installing light fixtures in various public buildings as follows: Chippewa Falls, Wis., for $994; Danville, Ky., at $961; Versailles, Ky., for $471; Winchester, Va., at $709; Jackson, Miss., for $2,212; London, Ky., at $1,448; Montgomery, Ala., for $289; Gulfport, Miss., at $994; New Orleans, La., for $2,474; Albuquerque, N. M., at $2,275; Baker City, Ore., at $885; Cheyenne, Wyo., for $640; Kewanee, Ill., for $688; Moline, Ill., at $1,331; Ruston, La., for $567, and Sault Ste. Marie, Mich., at $2,257.

TAMPA, FLA.—Plans are being made by the Tampa Electric Company for the installation of a 750-kw motor generator in the West Jackson Street power house. It is understood that contracts for machinery have been placed.

TAMPA, FLA.—The property and holdings of the Tampa-Sulphur Springs Traction Company is reported to have been purchased by Charles O. Brewster, of New York, N. Y. The officers of the new company are: Walter L. Weston, president and general manager; Peter O. Knight, vice-president; C. Fred Thompson, secretary, and F. Hathaway, treasurer. The company will retain the present name.

AMERICUS, GA.—It is reported that Mr. Rood, of Springfield, Mass., formerly president of the Hamilton Watch Company, has submitted a proposition to the City Council offering to guarantee the construction of an electric light plant and to establish an electric railway system in Americus, providing the city will grant necessary franchise and renew contract made several years ago, but which was not carried out by parties to whom the franchise was granted.

ATLANTA, GA.—The citizens are considering the question of installing a permanent ornamental electric lighting system for the main streets of the city. It is proposed to have the property owners along streets lighted bear the cost of the same. Forrest Adair is interested in the project.

ATLANTA, GA.—On July 7 Judge W. T. Newman of the United States Court confirmed the sale of the properties of the Etowah Power Company, which has extensive holdings along the Etowah River, to S. F. Smith, of the S. Morgan Smith Company, of York, Pa., for $160,000.

ATLANTA, GA.—The City Council has granted the Georgia Power Company a franchise in Atlanta for a term of 50 years. The company recently purchased the property and holdings of the North Georgia Electric Company at a receiver's sale. The power plant is located in Gainesville, Ga., and has its wires erected to the Atlanta city limits. The company is capitalized at $6,000,000 and bonds to the same amount have been issued. E. Elmer Smith, of York, Pa., is president, and L. F. Joerissen, of Atlanta, Ga., is treasurer.

CARTERSVILLE, GA.—It is reported that Hazlehurst & Anderson, of Atlanta, Ga., have been engaged by the Town of Cartersville to make a report on the electric and gas plants, with a view of issuing bonds for municipal improvements. For further information address Mayor Gilreath.

DALTON, GA.—Plans are being considered for the construction of an electric railway from Chattanooga, Tenn., to Dalton, Ga., with an extension to Chatworth, connecting with the Louisville & Nashville Railway.

HARTWELL, GA.—Preparations are being made by the Hart County Telephone Company for the installation of additional switchboard equipment.

MACON, GA—The business men of Cherry Street are forming an association for the purpose of installing a new electric illuminating system for Cherry Street. Plans prepared by J. E. Rood have been adopted. Joseph N. Neal is president of the association and F. H. Hyman is secretary and treasurer.

NICHOLS, GA.—The Nichols Telephone Company is reported to be in the market for wire and a complete telephone outfit. For further information address W. R. Frier, of Douglas, Ga.

ROYSTON, GA.—D. H. S. McGrary, chairman Methodist Episcopal Church, South, it is reported, would like to receive prices on an electric lighting plant.

SYLVANIA, GA.—Bids will be received until July 20 by the City of Sylvania for the construction of an electric light plant, the cost of which is estimated at $11,000. The J. B. McCrary Company, of Atlanta, Ga., has charge of the engineering work. A. B. Lovett is Mayor.

CLINTON, ILL.—The question of operating the pumping station of the municipal water works by electric motors, instead of steam power is under consideration.

JOLIET, ILL.—The Illinois Valley Gas & Electric Company, which recently purchased the electric plants at Dwight, Odell, Cornel, Streator, Ottawa and other places north of here, is erecting a high-tension electric line between Dwight and Joliet and intermediate points. As soon as this is completed a line will be erected from Dwight to Odell and Cornell.

LITCHFIELD, ILL.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Aug. 3, for construction of the United States post office, including plumbing, gas piping, heating apparatus, electric conduits and wiring, at Litchfield, Ill., in accordance with plans and specifications, copies of which may be obtained from the custodian of site at Litchfield, Ill., or at the above office. James Knox Taylor is supervising architect.

STREATOR, ILL.—Preparations are being made by the Illinois Valley Gas & Light Company for the construction of a 10,000-hp electric plant in Streator, Ill. Provision will be made to increase the output of the plant to 30,000 hp, as the service requires. The company is a subsidiary of the Economy Light & Power Company, of Joliet, Ill.

EVANSVILLE, IND.—The power house of the electric plant of the new city is completed and was put into operation for the first time July 2. The plant at first will furnish electricity for arc lamps for lighting the river bank and barges, so that work of pumping sand can be carried on at night. The administration building of the new city is nearing completion. The new city is being erected on the Kentucky side of the Ohio River and is to have no governing officials.

GOSHEN, IND.—Arrangements are being made by the Hawks Electric Company for the construction of a new steam generating plant. The company operates a 300-kw hydroelectric plant on the Elkhart River and has a steam auxiliary plant in its flour mill. The equipment of the new plant will include two water-tube boilers and a 500-kw, 2300-volt, three-phase, alternating-current turbo-generator set. It is understood that contracts have been placed for part of the equipment. F. J. Postel & Company, of Chicago, Ill., are consulting engineers.

MONROVIA, IND.—The Monrovia Mutual Telephone Company has increased its capital stock by $5,000. The company is planning to rebuild and extend its telephone lines.

PRINCETON, IND.—The Princeton Light & Power Company has filed an amendment to its charter increasing its capital stock from $75,000 to $100,000. The company is contemplating making extensive improvements and extensions to its plant. Henry C. Barr is president.

SHOALS, IND.—It is reported that work will commence at once on the construction of the new municipal electric light plant.

CALMAR, IA.—The citizens, on July 7, voted to grant a franchise to C. Miller & Sons, of Clermont, Ia., to construct and operate an electric plant in Calmar.

DECORAH, IA.—Sealed proposals will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Aug. 10 for the construction complete, including plumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office building at Decorah, Ia., in accordance with plans and specifications, copies of which may be obtained from the custodian of site at Decorah or at the above office. James Knox Taylor is supervising architect.

INDIANOLA, IA.—Preparations are being made for the installation of a Corliss engine and a 150-kw generator in the municipal electric light plant, bids for which have already been received. J. H. Clark is city clerk.

PAULLINA, IA.—The contract for the construction of the municipal electric light plant is reported to have been awarded to the Interstate Supply Company, of Sioux City, Ia., for $11,500.

WILSON, KAN.—Bids will be received at the office of N. Coover, city clerk, until Aug. 2 for material and labor for the construction of an electric light plant and water-works system, separate bids will be considered as follows: (1) For furnishing and installing pipe lines, including cast-iron pipe, valves, hydrants and specials. (2) Furnishing and erecting water tank, tower and foundations, 150 ft. to maximum water line, 75,000 gal. capacity. (3) Furnishing and installing internal combustion engines as follows with complete foundations: One 100 hp, one 50 hp and one 25 hp. (4) Furnishing and installing two triplex pumps, single acting, 200 gal. capacity; one for direct connection to motor and the other for direct connection to engine. (5) Furnishing and installing generators and apparatus as follows: One 75-kw and one 35-kw, three-phase, 2300-volt, 60-cycle generator, and switchboard; one 8-kw constant current transformer; one 25-hp, 2300-volt, three-phase motor. (6) Furnishing and erecting transmission lines, including poles, cross-arms, transformers, street lamps, wire, etc. The above to be furnished and work done in accordance with plans and specifications on file at the office of the city clerk or at the office of George P. Taylor, engineer, Stockton, Kan. Extra copies of plans and specifications can be secured of the engineer for $4. D. E. O'Donnell is Mayor.

WHITESBURG, KY.—Preparations are being made by the Whitesburg Light & Power Company for the installation of an electric light plant, at a cost of about $2,500, to be operated by water power. It is understood that contracts have been placed for machinery. J. L. Coleman is manager.

NEW ORLEANS, LA.—It is reported that Penick & Ford, Ltd., of New Orleans, La., are in the market for three generating sets with ratings of 100, 75 and 50 kw, respectively, 250 volts, each to be driven by a direct-connected engine of simple four-valve or Corliss type.

PHILLIPS, MAINE.—At a town meeting held recently the citizens voted to enter into a contract with the Phillips Lumber & Electric Company for street lighting for a term of five years, under which the company is to furnish 42 incandescent street lamps of 32 cp at $13.99 per lamp per year, for up-to-midnight service. If the town corporation votes for an all-night service any time during the life of the agreement contract the company is to furnish the same for $400 additional per annum.

Owing to a disagreement between local factions the streets have not been lighted since last April.

BOSTON, MASS.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 23 for extensions to underground conduit system for electrical conductors at the Navy Yard, Boston, Mass. Plans and specifications can be obtained on application to the above bureau or to the commandant of the navy yard named. R. C. Hollyday is chief of bureau.

MILFORD, MASS.—The Board of Selectmen has entered into a contract with the Milford Electric Light & Power Company for lighting the streets of the town for a period of three years, under the terms of which the company is to supply 17 arc lamps instead of 42 as at present and 134 tungsten lamps instead of 72 furnished under the present contract, for which the town is to pay $5,000 per year. All additional arc lamps furnished will cost $105 each per year and tungsten lamps $24 each per annum.

PITTSFIELD, MASS.—The General Electric Company has awarded the contract for the construction of a large addition to the power house at the Stanley plant to Beckwith & Pike. The cost of the building and equipment is estimated at about $500,000.

WEBSTER, MASS.—The Webster & Southbridge Gas & Electric Company has recently placed an order with the Allis-Chalmers Company, of Milwaukee, Wis., for a 1000-kw, three-phase, 2300-volt, 60-cycle, 3600 r. p. m. steam turbo-generator set, which will operate in parallel with the present 500-kw machine.

WOBURN, MASS.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Aug. 9 for the construction complete, including plumbing, gas fitting, heating apparatus, electric conduits and wiring, of the United States post office at Woburn, Mass., in accordance with drawings and specifications, copies of which may be obtained from the custodian of site at Woburn, Mass., or at the above office. James Knox Taylor is supervising architect.

WORCESTER, MASS.—The Worcester Electric Light Company has announced a reduction in the price of tungsten lamps from 65 cents to 50 cents on the 25 and 40-watt lamps and will also renew incandescent lamps without charge.

BAY CITY, MICH.—Plans are being prepared by Bradley, Miller & Company, of Bay City, Mich., for the construction of a new box factory, which will probably be equipped for electric motor drive throughout.

DETROIT, MICH.—The Anderson Forge & Machine Company is reported to be contemplating the construction of a new power plant to furnish electricity to operate the machinery of its works.

MUSKEGON, MICH.—The Linderman Machine Company, of Muskegon, Mich., is erecting a new building 66x106 ft., the equipment of which will include a 10-ton traveling crane, electric and pneumatic tools, etc. The company, it is said, will also increase its power and compressor equipment.

AURORA, MINN.—The Village Council is reported to have awarded the contract for the installation of the electrical equipment for the municipal electric light plant to the Marshall-Wells Hardware Company, of Duluth, Minn., for $2,300.

AUSTIN, MINN.—It is reported that an election will be held to vote on the proposition to issue $30,000 in bonds, the proceeds to be used for electric light, power and water extensions.

BIWABIK, MINN.—It is reported that bonds have been voted for the construction of an electric light plant in Biwabik, Minn.

DE SOTO, MINN.—The City Council is considering the question of installing a municipal electric lighting system in connection with the water works plant. Ward Cunningham is Mayor.

EAST GRAND FORKS, MINN.—Preparations are being made by the Tri-State Telephone Company for the installation of a telephone system in East Grand Forks to cost about $20,000.

MINNEAPOLIS, MINN.—Bids will be received until July 29 at the office of Henry N. Knott, city clerk, for furnishing the City of Minneapolis, Minn., electricity to operate a 20,000,000-gal centrifugal pumping engine, according to specifications on file in the office of the supervisor of water-works.

MINNEAPOLIS, MINN.—Sealed bids will be received at the office of Henry N. Knott, city clerk, until July 29 for furnishing the City of Minneapolis, Minn., one 20,000,000-gal. electrically driven centrifugal pumping engine and one vertical triple expansion pumping engine, according to plans and specifications which are on file at the office of the city engineer

WILLMAR, MINN.—The City Council has passed an ordinance authorizing the erection of a local telephone exchange to cost $35,000.

INDEPENDENCE, MO.—The City of Independence has purchased a 500-kw General Electric turbo-generator unit complete for the municipal electric plant from the John A. Stewart Electric Company of Cincinnati, Ohio, to provide for increased demands made upon the plant.

INDEPENDENCE, MO.—The City Council is contemplating an issue of $15,000 in bonds, the proceeds to be used for improvements to the municipal light plant. A new turbine will be installed at a cost of $9,000, and additions will be made to the power house and street lighting system to cost $6,000.

LATHROP, MO.—Arrangements are being made by the Clover Leaf Telephone Company to place all its wires in cables in the business section of the town.

ST. LOUIS, MO.—According to the annual report submitted to the Board of Public Works the city hall electric light plant showed a large saving last year. The plant supplies electricity for lamps and motors in the city hall, four courts, police headquarters, first district police court, court house and old city hall. The report shows the total cost of operating the plant, including heat for the city hall, to have been $21,940. Electricity alone furnished by the plant, if secured from the Union Electric Light & Power Company at the rate charged the city, 4.5 cents per kw-hour, would have amounted to $31,293.

FORT MISSOULA, MONT.—Bids will be received by A. B. Shattuck, constructing quartermaster, until July 30 for construction of a reinforced concrete pumping station, furnishing and installation of all boilers, steam pumps, valves, etc. Alternate bids will be received for pumping station using motor-driven pumps, including motors, pumps, etc. In applying for specification bidders should designate whether they wish to bid on steam or electrically driven pumps. A deposit of $5 will be required on each set of plans, which can be secured on application to the constructing quartermaster.

ALLIANCE, NEB.—Plans are being prepared by Grant & Letton, Lincoln, Neb., for the construction of an electric light plant and water works system in Alliance, the cost of which is estimated at $95,000.

BELGRADE, NEB.—At an election held recently bonds to the amount of $18,000 were voted, the proceeds to be used for the construction of an electric light plant and water works system.

SUTTON, NEB.—The Sutton Telephone Company is reported to have purchased a site in Sutton, on which it will erect a new exchange building.

BURLINGTON, N. J.—Mayor Farner on July 5 vetoed the ordinance granting to the syndicate, which recently purchased the property of the Burlington Electric Light & Power Company, a 50-year franchise to furnish electrical service in Burlington. His action blocks the plans of the promoters to secure the franchise before the new Public Utilities Commission becomes operative.

FORT BAYARD, N. M.—The contract for equipment for the cold storage and power plant at Fort Bayard, N. M., has been awarded to J. B. Downey as follows: Boilers and boiler room equipment, $17,000; engines and generators, at $9,400; switchboard, $3,500; remodeling distributing system, $2,450; tungsten street lighting system, $1,400, and meters, $1,000. The refrigerating plant will be installed by the Creamery Package Manufacturing Company.

ALBANY, N. Y.—Bids will be received by the State Commission in Lunacy, Albany, N. Y., until July 27 for work at Central Islip State Hospital, Kings Park State Hospital and Manhattan State Hospital, as follows: For Central Islip State Hospital, Central Islip, N. Y., kitchen and dining room building, conduits, steam mains, feeder cables and outside sewer and water connections for new group, additional boiler capacity, North Colony, construction, including heating, plumbing and electric work. For Kings Park State Hospital, Kings Park, N. Y., kitchen and dining room building, conduits, steam mains, feeder cables, sewer and water connections for new groups, construction including heating, plumbing and electric work. For Manhattan State Hospital, Ward's Island, New York City, kitchen building, steam mains and feeder cables for new cottages, construction including heating, plumbing and electric work. Drawings and specifications may be consulted and blank forms of proposals obtained at the institution for which the work is advertised, or for all the work, at the office of the State Commission in Lunacy, 1 Madison Avenue, New York, N. Y., or at the office of the state architect, Franklin B. Ware, Albany, N. Y. T. E. Garr is secretary of the Commission.

BROOKLYN, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., until July 18 for repairs, alterations and additions to the electric equipment in Public Schools 16, 58 and 108, Borough of Brooklyn, N. Y. Blank forms, plans and specifications may be obtained or seen at the above office, also at branch office, 131 Livingston Street, Brooklyn, N. Y.

BUFFALO, N. Y.—The City Council is considering the question of installing two steam turbo-generators with a rating of 500 kw to operate the three electric pumps in the new pumping station.

BUFFALO, N. Y.—The Niagara & Erie Power Company, a new company which has been formed to take over the electrical distributing department of the Buffalo & Lake Erie Traction Company and the Niagara, Lockport & Ontario Company, including the furnishing of electricity for lamps, heat and motors to local communities, has notified the Public Service Commission, Second District, that it will file an agreement with the Commission that the existing rates for electrical service will not be changed upon its assumption of the properties.

LIMA, N. Y.—The Lima-Honeoye Light Company has applied to the Public Service Commission, Second District, for permission to take over the property and franchises of the Lima-Honeoye Electric Light & Railroad Company to be operated under lease. The Lima-Honeoye Light Company has also petitioned for authority to issue $5,000 in capital stock, the proceeds to be used for improvements and maintenance of the electrical plant, distributing system and railway system.

LIVONIA, N. Y.—The Livonia Light & Heat Company, of Livonia, N. Y., has applied to the Public Service Commission, Second District,

for permission and approval of commencement of construction and the exercise of rights under franchises granted by the Town Board and Highway Commissioners of the towns of Livonia, Lima and Avon.

NEW YORK, N. Y.—Bids will be received until July 18 by C. B. J. Snyder, superintendent of school buildings, Department of Education, Park Avenue and Fifty-ninth Street, New York, N. Y., for repairs, alterations and additions to the electric equipment Public School 2, Third Avenue and 169th Street, Borough of Bronx, Public School 157, St. Nicholas Avenue and 127th Street, and Public School 147, Henry, Orchard and Gouverneur Streets, Borough of Manhattan; also for new water main and electric pump, etc., at Public School 62, Hester, Essex and Norfolk Streets, Borough of Manhattan. Plans and specifications can be seen at the office of the superintendent, Park Avenue and Fifty-ninth Street, Borough of Manhattan.

NEW YORK, N. Y.—Sealed proposals will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until July 30, for furnishing condensers, piping, equipment, etc., for power plant for Navy Yard, New York, N. Y., plans and specifications for which can be obtained on application to the above bureau or to the commandant of the navy yard named. The cost of the work is estimated at $46,000. R. C. Hollyday is chief of bureau.

NEW YORK, N. Y.—The Board of Public Service, Second District, has approved the terms of the franchise recently granted by the Board of Estimate and Apportionment to the Union Railway Company for the construction of an extension of its electric railway from the intersection of Sedgwick Avenue and Fordham Road in the Bronx across the Harlem River Bridge at 207th Street to connect with the Third Avenue Railroad system at Emerson Street and Broadway.

NEW YORK, N. Y.—Announcement has been made that bids will be called for in the near future for the construction of the Broadway-Lexington Avenue subway system. Details of contracts are now being completed by the engineers.

OLEAN, N. Y.—The Olean Electric Light & Power Company has applied to the Public Service Commission for permission to issue $50,000 in capital stock, the proceeds to be used to pay for additions and extensions to its plant already made and the completion of others under way.

OSSINING, N. Y.—The New York, New Haven & Hartford Railroad Company, which recently acquired control of the local electric railway, is reported to be negotiating with F. A. Stratton for the Hudson River & Eastern Traction Company's system. The Hudson River company operates an electric railway in Ossining. Arrangements had been made by the company some years ago to extend the railway to White Plains, passing through Briarcliff and Pleasantville. The New York, New Haven & Hartford Railroad Company, it is said, if it secures control of the system, will extend the lines to White Plains and to Port Chester, thereby completing its control of the electric railway system in the county.

OSWEGO, N. Y.—An order has been placed by the National Starch Company with the Allis-Chalmers Company, of Milwaukee, Wis., for a 937-kva, 480-volt, three-phase, 60-cycle, 1800 r. p. m. steam turbo-alternator. Excitation for this will be supplied by a small generator coupled to an extension of the turbine shaft. A type "C" Allis-Chalmers condenser will be used to maintain the vacuum.

PALMYRA, N. Y.—The Public Service Commission, Second District, has granted permission to the Palmyra Gas & Electric Company, of Palmyra, N. Y., the Newark Gas Light & Fuel Company, the New Light, Heat & Power Company, of Newark, N. Y., the Lyons Gas Light Company, of Lyons, N. Y., and the Wayne County Electric Company, of Lyons, N. Y., to consolidate under the name of the Wayne County Gas & Electric Company. The company is to be capitalized at $200,000, which is $45,000 less than the total of the capital stock of the companies consolidated.

RICHFIELD SPRINGS, N. Y.—The Richfield Springs Electric Light & Power Company has agreed to comply with the directions of the Public Service Commission, Second District, and has undertaken a contract to furnish the village with alternating-current arc lamps at the rate of $59.50 per lamp per year and to furnish electricity for lighting the hose house free of charge. The Public Service Commission, Second District, recently denied the application of the Hartwick Power Company for permission to furnish electrical service in Richfield Springs on the ground that the village is already served by the Richfield Springs Electric Light & Power Company; at the same time instructed the last-named company to make improvements to its plant and improve its service.

GASTONIA, N. C.—The City Council has granted the Isothermal Traction Company a franchise to construct an interurban electric railway through the streets of Gastonia. The company proposes to build an electric railway which will ultimately extend to Asheville, 90 miles distant.

WALLACE, N. C.—The Western Assurance Company, of Wallace, N. C., it is reported, would like to communicate with manufacturers of equipment and also contractors of electric light plants.

CLEVELAND, OHIO.—Bids for furnishing light, heat and power for the county buildings for a period of six years were submitted to the County Buildings Commission as follows: The lowest bid was submitted by the Cleveland Electric Illuminating Company, which offered to supply electricity for lamps at 3¾ cents per kw-hour; 4¾ cents per kw-hour for motors and 35 cents per 1000 lb. pressure for steam heating purposes. The Strong, Carlisle & Hammond Company offered to furnish electricity for lamps and motors at 4 cents per kw-hour and steam for heating purposes at 40 cents. The bid of the Cleveland Light & Power Company was 5 cents per kw-hour for energy for lamps; 4¾ cents per kw-hour for power and 35 cents for steam. Bids were also submitted for the construction of a power house and equipment. Only one complete bid was received in this class, which was submitted by John Grant & Son, at $357,000 for plant, with $95,000 additional if a tunnel is constructed. The bid for the building alone was $147,000.

HUDSON, OHIO.—It is reported that plans have been prepared by D. M. Hosford, engineer, Caxton Building, Cleveland, Ohio, for municipal improvements in Hudson, including an electric light plant, contracts for which will be placed in the near future. The specifications call for a 150-hp gas engine, gas producer and a generator with a rating of 100 kw.

YOUNGSTOWN, OHIO.—Plans are being prepared by the Osborn Engineering Company, of Cleveland, Ohio, for enlarging the plant of the Republic Rubber Company, of Youngstown, Ohio, which will include the erection of an addition 80x200 ft., five stories high. Later, it is said, the company will enlarge its power plant.

ALTUS, OKLA.—The City of Altus has awarded contracts for improvements to the municipal electric light plant, water works and sewer systems, amounting to $200,000, to the H. W. Maxey Contracting Company, of Houston, Tex. The work on the electric plant will cost $35,000 and the water works $130,000 and will include bringing the water from a point about seven miles north of the city; the water will be pumped by electricity furnished from the central station.

ALTUS, OKLA.—The Pioneer Telephone Company, of Oklahoma City, Okla., has purchased the properties of the Leger & Chickasha Telephone Company and the Mangum & Quanah Telephone Company, the total consideration being $90,000; $60,000 for the Leger & Chickasha property and $30,000 for the Mangum & Quanah holdings. The systems include three exchanges and nine toll lines of the Leger & Chickasha company and two exchanges and eight toll lines of the Mangum and Quanah property, all having headquarters in Altus. There are also 14 rural lines operated out of Altus in connection with the Altus exchange. It is understood that extensive improvements will be made by the new owners. E. B. Jeffrey, C. C. Henry, J. R. McMahan and C. C. Hightower, all of Altus, Okla., are the principal stockholders.

FORAKER, OKLA.—Preliminary plans have been prepared by F. H. Lancashire, of Dallas, Tex., for the construction of an electric light plant and water works system in Foraker, for which bonds to the amount of $30,000 have recently been voted. It is said that as soon as plans are completed the town will advertise for bids for same. W. L. Leaton is town clerk.

HOBART, OKLA.—The Hobart Light & Power Company is planning to rebuild its overhead distributing system in the residence section.

OSAGE, OKLA.—The Osage Land & Development Company is reported to be contemplating the construction of an electric light plant in Osage, Okla. The office of the company is located at 500 North Broadway, Oklahoma City, Okla.

ASHLAND, ORE.—At an election held June 27 the citizens voted in favor of the proposition to issue $55,000 in bonds, the proceeds of $25,000 to be used to complete the municipal electric plant and $30,000 for paving. M. F. Eggleston is recorder.

KLAMATH, ORE.—Plans have been prepared by the Midway Telephone & Telegraph Company for rebuilding its entire system in Klamath Falls, work on which will begin the latter part of this month. A complete central energy system will be installed and the wires placed underground on Main Street. A 1600-line switchboard will be installed.

PORTLAND, ORE.—The headquarters of the Pacific Power & Light Company, a subsidiary of the American Power & Light Company, of New York, N. Y., will be located in Portland, Ore., with branch offices in the various towns where its properties are located. The properties purchased are as follows: Astoria gas plant, electric plant and street railway system; Pendle gas plant and electric plant; Adams electric plant; Freewater electric plant; Walla Walla gas plant, electric plant, street railway system and interurban railway to Milton and Freewater; Lewiston gas plant; Pasco water-works and electric plant; Kennewick water-works and electric plant; Sunnyside electric plant; Mabton electric plant; Wapato electric plant; North Yakima Gas plant, electric plant and water-works. The company will own steam generating plants at Astoria, Walla Walla and Kennewick, a hydroelectric plant at Walla Walla River, and combined steam and hydroelectric plants at North Yakima and on the Natchez River, 10 miles above North Yakima. The company is capitalized at $7,500,000.

EASTON, PA.—Plans have been prepared by M. H. Treadwell & Company, of Lebanon, Pa., Stoever Foundry & Manufacturing Company, of Myerstown, Pa., and the Lebanon Steel Castings Company, of Lebanon, Pa., for the erection of combined plants on a tract of 28 acres in Easton, Pa., recently acquired. The new plant will be equipped for electrical operation throughout.

NEKODA, PA.—The Pfoutze Valley Telephone Company has increased its capital stock from $5,000 to $40 000. E. T. Troutman, of Millerstown, Pa., is secretary.

NEW CUMBERLAND, PA.—Preparations are being made by the Susquehanna Woolen Mill Company to change its motive power from steam to electricity. It is proposed to erect a new building and install a new boiler and a 150-kw generator, which will supply electricity for lamps and motors for the mill.

PHILADELPHIA, PA.—The Pomeroy Construction Company is reported to be estimating on plans and specifications for the construction and completion of the addition to the Passyunk power house, located at Twentieth Street and Oregon Avenue, for the Girard estate.

PITTSBURGH, PA.—W. P. Fraser, of the Highfield Company, owner of Morewood Heights, with other property owners in the vicinity of Morewood Heights, has organized the Squirrel Hill Electric Light Company. It is proposed to erect an electric light plant on Beeler Street some distance from Moorewood Heights to supply electricity for lighting residences in the Shadyside-Squirrel Hill district. The cost of the plant is estimated at about $100,000, and will be operated entirely by gas engines.

YORK SPRINGS, PA.—It is reported that York capitalists have purchased the Deardorffs Mills, near York Springs, and propose to erect an electric plant to furnish electricity in York Springs for lamps and motors.

CHARLESTON, S. C.—The capital stock of the Charleston Consolidated Railway, Gas & Electric Company has been increased from $1 500,000 to $2,000,000. It is reported that the company is contemplating making improvements to its system.

RAPID CITY, S. D.—Announcement has been made by the Dakota Power Company, which is now erecting a power plant on Rapid Creek, near Rapid City, to furnish electricity in this city, that it proposes to construct an auxiliary steam plant and an electric railway in Rapid City. L. A. Richards is president of the company.

CHATTANOOGA, TENN.—The Chattanooga & Tennessee River Power Company has engaged Jacobs & Davies, 30 Church Street, New York, N. Y., to complete its hydroelectric plant at Hale's Bar on the Tennessee River. It is understood that about 50 per cent of the work has been completed. About 50,000 hp will be developed.

CLEVELAND, TENN.—The plant and holdings of the Cleveland Electric Light Company have been purchased by J. W. Adams, of Chattanooga, Tenn., and associates for $25,000. The new owners are reported to be contemplating the construction of a dam 125 ft. high to develop the power of the Oconee River.

CLEVELAND, TENN.—The Union Improvement Company has been granted a franchise for the construction and operation of an electric system in Cleveland. The company has the privilege of building both overhead and underground distributing systems. The franchise is to be forfeited if the system is not in operation within two years.

GEORGETOWN, TENN.—It is reported that a local telephone company has been organized in Georgetown and proposes to erect an exchange system in this place. It is said that a trunk line will be built, connecting with the Cleveland Telephone Company, of Cleveland, Tenn.

BROWNSVILLE, TEX.—The question of making improvements to the municipal electric light plant is reported to be under consideration. It is said that about $15,000 will be expended.

FRIONA, TEX.—Plans are being considered by the Citizens' Cooperative Development Company for the construction of an electric light plant in Friona. C. C. Fredericks, Carson Building, Amarilla, Tex., is president of the company.

PALESTINE, TEX.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Aug. 19 for the construction, including pumbing, gas piping, heating apparatus, electric conduits and wiring, of the United States post office in Palestine in accordance with plans and specifications, copies of which may be obtained at the above office or from custodian of site.

SAN AUGUSTINE, TEX.—The property and franchise of the San Augustine Light & Power Company have been purchased by E. E. Jeanes Lumber Company, which, it is said, will rebuild the power house, recently destroyed by fire. At present the town is without electric service.

WOODWARD, TEX.—The townsite of Woodward has been purchased by M. Bargas Company, of San Antonio, Tex., which will be further developed for a resort. Improvements will be made including the installation of electric light, water works, sewerage systems and other public utilities.

SALT LAKE CITY, UTAH.—A letter has been filed with the city recorder by R. J. Robinson, engineer, submitting a proposition relative to installing a power plant in City Creek Canyon. Mr. Robinson states that he has located water rights, which have been approved by the State engineer. He proposes to take water from the creek at a point about 2 miles above the forks of the canyon and convey it to the power plant at a point 3 or 4 miles down the canyon through a 30-in. pipe.

ALTAVISTA, VA.—Contracts have been awarded by the Altavista Cotton Mill Company, of Altavista, Va., for construction of its plant. The equipment will include 13,000 spindles and 300 looms which will be equipped for electric motor drive.

FORT MONROE, VA.—Sealed bids will be received at the office of the constructing quartermaster, Fort Monroe, Va., until July 18 for construction of addition to hospital at Fort Monroe, including plumbing, heating and electric wiring and fixtures. Plans and specifications are on file in the office of the chief quartermaster, Department of the East, Governor's Island, New York, and at the above office. A deposit of $25 will be required to secure return of plans and specifications. Captain Ernest R. Tilton is constructing quartermaster.

NEWPORT NEWS, VA.—The contract for piping, conduit and heaters for the navy yard power plant at Charleston, S. C., has been awarded to the Newport Contracting & Engineering Company, of Newport News, Va., for $16,811.

RICHMOND, VA.—The Council Committee on Electricity has awarded the contract for underground connections for the proposed Broad Street ornamental lamps to the McKay Engineering Company. This is simply an increase of the original contract with the company.

STAUNTON, VA.—The Board of Aldermen on June 27 refused to concur in the action of the Common Council in approving the contract with the Staunton Lighting Company to light the streets of the city for a term of 15 years for $6,000 per year, with additional lamps in proportion. The city owns and operates a municipal electric plant.

MEADOW LAKE, WASH.—The Washington Water Power Company, of Spokane, Wash., is reported to have completed plans for the installation of an electric lighting system in Meadow Lake.

WILSON, WASH.—Arrangements have been completed for the extension of the telephone line of the Pacific Telephone & Telegraph Company from Wilson Creek to Soap Lake and Ephrata.

FAIRMONT, W. VA.—Overhead construction has commenced on the Fairmont & Northern Traction Company's railway at Fairview and will be completed as far as Granttown by September, a distance of six miles. D. L. Evans is superintendent of line construction.

APPLETON, WIS.—Arrangements are being made by the Wisconsin Traction, Light, Heat & Power Company for the construction of a dam on the Wolf River, at Gardner's dam, 35 ft. high. From there water will be carried through two flumes one and one-half miles to the site of the power plant, which will give a fall of 95 ft. Electricity generated at the plant will be utilized to operate an interurban railway in the Fox River Valley, owned by the Wisconsin Traction, Light, Heat & Power Company. John I. Beggs, of Milwaukee, Wis., is president of the company.

BROWNTOWN, WIS.—Bids will be received until Aug. 1 by the Village Clerk, Browntown, Wis., for the construction of an electric light plant to be driven with gasoline engines. C. B. Stewart, of Madison, Wis., is consulting engineer.

HIGHLAND, WIS.—The Wallace Mining Company, of Highland, Wis., is planning to increase the output of its electric plant. The equipment will include an electric generator and other apparatus.

LARSEN, WIS.—The capital stock of the Larsen Telephone Company has been increased from $10,000 to $15,000.

OCONTO FALLS, WIS.—Preparations are being made by the Morgan Telephone Company, recently organized, to erect a telephone system. It is understood that connections will be made with the Little River Telephone Company.

TWO RIVERS, WIS.—Arrangements are being made by the Nelson Lumber Company, of Two Rivers, Wis., for enlarging its mill. It is understood that the company will require woodworking and power machinery and probably electric motors.

WEST ALLIS, WIS.—The Milwaukee Machine Tool Company is reported to be contemplating the purchase of power equipment for its West Allis plant, including an engine, generator, boiler of from 80 to 100 hp and a number of electric motors.

SHERIDAN, WYO.—Representatives of the Ohio syndicate which was recently granted a franchise to construct an electric railway in Sheridan have filed their bond and it is expected that work on construction of the railway will begin soon. Later a railway will be built to Kooi, via Fort MacKenzie, a distance of 14 miles.

WHEATLAND, WYO.—Bids will be received until July 15 by the Town of Wheatland, Wyo., for the construction of an electric light plant, water works and sanitary sewer, plans and specifications for which may be seen at the office of the town clerk, or the office of J. C. Hadsall, engineer, Wheatland, Wyo. Plans may be obtained from the engineer by depositing the sum of five dollars, which will be refunded upon return of the same. Charles G. Buechner is town clerk.

VANCOUVER, B. C.—Arrangements are being made by the British Columbia Electric Railway Company for the construction of its new power plant in the Chilliwack district, work on which will soon commence. Power for operating the plant will be secured from Jones Lake, 18 miles east of Chilliwack, and Chilliwack Lake, 23 miles southeast of Chilliwack. The tunnel from Chilliwack is to be 14 x 16 ft. and 5¼ miles in length, and the tunnel from Jones Lake will be 10,200 ft. long.

INGERSOLL, ONT., CAN.—The City Council has engaged Robert A. Ross, of Montreal, Que., Can., to prepare plans, secure tenders and supervise the work of making the necessary changes for operating the electric plant recently acquired from the Ingersoll Electric Power & Light Company for receiving and distributing Niagara power from the Hydro-Electric Power Commission, work on which will begin at once.

NEW HAMBURG, ONT., CAN.—Sealed proposals will be received by the Municipality of New Hamburg, Ont., until July 18 for 13200-2300-volt transformers, switching apparatus, protective apparatus, street lighting apparatus, distributing transformers and maximum demand apparatus. For further information address William Millar, town clerk, New Hamburg, Ont., or from Edward P. Merrill, engineer, 59 Yonge Street, Toronto, Can., where specifications can be seen, etc.

TORONTO, ONT., CAN.—The offer of the Toronto Electric Light Company submitted to the City Council, details of which were published

in the issue of June 16, has been considered by the Board of Control and rejected. The board suggested that the only basis on which negotiations could be entered into by the city was the sale of the company's plant to the city at a reasonable figure.

MONTREAL, QUE., CAN.—The City Council, acting on a report of the Board of Control, has decided to terminate the street lighting contract with the Montreal Light, Heat & Power Company on Oct. 31, 1910.

MOOSE JAW, SASK., CAN.—Sealed tenders will be received by W. F. Heal, city clerk, until July 18 as follows: Contract "A"—Supplying material and constructing sewage disposal plant, complete and laying trunk sewer. Contract "B"—(1) Supplying and installing a complete air-lift system. (2) Supplying and installing one electrically-driven centrifugal pump and auto-starter. Contract "C"—Supplying and delivering 3000 cords of field stone. Plans and specifications may be seen at the office of J. M. Wilson, city engineer, Moose Jaw, Sask., Room B 33, Board of Trade Building, Montreal, Que., Can., and Room 404 Builders' Exchange Building, Winnepeg, Man., Can.

New Industrial Companies.

THE AKRON ROTARY ENGINE COMPANY, of Akron, Ohio, has been incorporated with a capital stock of $10,000 by C. E. Forsyth, Leo G. Fedderman, I. M. Forsyth, A. Fedderman and A. S. Mottinger.

THE ALBANY ELECTRIC SUPPLY COMPANY, of Albany, Ga., has been incorporated with a capital stock of $2,500 by L. Lewenstein, S. Farkas and R. Lewenstein. The company is a reorganization of the Albany Engineering Company, which will handle electric supplies, equipping buildings, etc.

THE AMERICAN ELECTRIC HEADLIGHT COMPANY, of Indianapolis, Ind., has been chartered with a capital stock of $50,000 for the purpose of manufacturing and selling headlights for use on locomotives, engines and other vehicles and conveyances. The directors are: Charles S. Stone, Charles N. Elliott and Harry B. Gates.

THE AUTOMATIC ENUNCIATOR COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $500,000 by S. F. Harris, W. I. Patton and A. E. Wilson, of Chicago, Ill. The company proposes to manufacture electrical supplies and apparatus.

THE AUTO ELECTRIC-LITE COMPANY, of Indianapolis, Ind., has been incorporated with a capital stock of $15,000 for the purpose of manufacturing and selling electric generating machinery and devices. The directors are: E. V. McCloud, O. M. Fish, W. F. McCloud and George L. Fish.

THE BANNER SAFETY LAMP COMPANY, of New York, N. Y., has been incorporated by Henry C. Hepburn, Edwin M. Post and H. C. Hepburn, all of Babylon, N. Y. The company is capitalized at $10,000 and proposes to manufacture electrical apparatus and devices.

THE DOWLING ENGINE WORKS, of Biloxi, Miss., has been organized with a capital stock of $100,000 to manufacture a headless twin cylinder engine. E. J. Dowling is interested in the company.

THE F. & J. AUDITORE COMPANY, of Brooklyn, N. Y., has been chartered with a capital stock of $25,000 by V. Ajello, J. Catanzaro and J. G. Stockman, all of Brooklyn, N. Y. The company proposes to do a general contracting business, building railways, light and power plants, real estate and building, sewers, reservoirs, etc.

THE GARRETSON ENGINEERING COMPANY, of Buffalo, N. Y., has been incorporated with a capital stock of $100,000 by Albert D. Garretson, H. O. Garretson and William M. Hoffman, all of Buffalo, N. Y. The company proposes to manufacture engines, boilers, dynamos, etc.

THE GEORGE W. MULLER INTERIOR COMPANY, of Rome, Tenn., has been chartered by George W. Muller, of Atlanta, Ga.; John M. Graham, J. L. Bass, C. R. Porter and J. B. Sullivan, Jr., all of Rome, Tenn. The company is capitalized at $300,000 and will manufacture interior fittings, telephone booths, etc.

THE GIFFORD CONSTRUCTION COMPANY, of Borough of Queens, N. Y., has been incorporated with a capital stock of $10,000 by George H. Gifford, 400 Hillside Avenue, Jamaica, N. Y.; Allen B. Gifford, of Valley Falls, N. Y., and Leslie P. Gifford, of Valley Falls, N. Y. The company proposes to do a general contracting and construction business.

THE HAMPSHIRE MANUFACTURING COMPANY, of New York, N. Y., has been chartered by C. J. Kleber, of New York, N. Y.; J. McGregor, of Springfield, Mass., and J. H. Kaesen, of New York, N. Y. The company is capitalized at $125,000 and proposes to manufacture and deal in machinery, tools and appliances.

THE HAZARD MANUFACTURING COMPANY, of Gates, N. Y., has been incorporated by E. C. Hazard, G. E. Hazard, J. F. Alden, of Rochester, N. Y. The company is capitalized at $400,000 and proposes to manufacture marine and automobile gas engines, etc., and to carry on a general machinery manufacturing business.

THE INTERURBAN CONSTRUCTION COMPANY has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000. The incorporators are: D. B. Wynn, J. K. Orvis and H. J. Farmer, of Waukegan, Ill.

THE LOWERATOR COMPANY, of New York, N. Y., has been chartered with a capital stock of $100,000 by George W. Younkman, A. G. Martin and Henry J. Martin, all of Brooklyn, N. Y. The company proposes to manufacture and deal in hoisting machinery, elevators and fire escapes; also to do a general electrical and mechanical engineering business.

McGLYN, HAYS & COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000 to manufacture engines, elevator machinery, shafting, etc. The incorporators are: Thomas P. McGlynn, of Montclair, N. J.; Henderson B. Hays, of Montclair, N. J., and Elmer E. Cooley, 223 West 104th Street, New York, N. Y.

THE MUTUAL LAMP MANUFACTURING COMPANY, of New York, N. Y., has been chartered by Sigmund Thau, Louis Zankel, Solomon J. Stadler, all of New York, N. Y. The company is capitalized at $3,000 and proposes to manufacture and deal in oil, gas and electric lamps and shades, etc.

THE SHORES-IRWIN ELECTRIC COMPANY, of Spartansburg, S. C., has been organized for the purpose of doing a general engineering and contracting business. The company is the result of the purchase of a half interest in the Shores Electric Company by W. H. Irwin. J. H. Shores, R. A. Shores and W. H. Irwin are interested in the company.

THE SPENCER AIR PURIFYING COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $5,000 for the purpose of manufacturing machinery of all kinds and to deal in railroad equipment. The incorporators are: George M. Spencer, of St. Louis, Mo.; Edward B. McKellar, Sixth Street, Garden City, N. Y.; Charles B. Price, Fifth Avenue, Mt. Vernon, N. Y., and Vernon Terrance, of East Orange, N. J.

THE TREACY IRON WORKS, INC., of Brooklyn, N. Y., has been chartered with a capital stock of $5,000 for the purpose of doing an iron and steel contracting and construction business. The incorporators are: Louis V. P. Treacy, 600 East 164th Street, New York, N. Y.; Henry Wenz, Long Island City, N. Y., and H. M. Hebberd, of Brooklyn, N. Y.

New Incorporations.

HANFORD, CAL.—The Hanford & Summit Lake Railway Company has been chartered with a capital stock of $15,000 to construct an electric railway through Grangeville and Hardwick into the Summit Lake region, returning through Lemoore and Armonia. The railway, including an extension to Laton, will be 15 miles in length. The incorporators are: Charles R. Harwick, J. O. Hickman, George C. Ayedelott, of Hanford, Cal.; Ralph W. Heins, of Santa Cruz, Cal., and Clifford McClellan, San Francisco, Cal.

SAN FRANCISCO, CAL.—Articles of incorporation have been filed for the Bay Cities Home Telephone Company by James Lanagan, Guy Knupp, H. T. Bailey, C. F. Mohler, E. C. McDonough, J. E. O'Brien, N. J. Prendergast and others. The company is capitalized at $20,000,000.

WILMINGTON, DEL.—The Kermont Lighting Company has been chartered with a capital stock of $25,000 by Christian Douch, of Philadelphia; William H. Daart, of Harrisburg, Pa., and Martin E. Smith, of Wilmington, Del.

WILMINGTON, DEL.—Articles of incorporation have been filed with the Secretary of State by the Standard Gas & Electric Company with a capital stock of $24,000,000. The incorporators are: John S. Stubbs, James P. Murray and Edgar E. McWhiney, of Philadelphia, Pa.

WILMINGTON, DEL.—The Standard Light Company has filed articles of incorporation with the Secretary of State. The company is capitalized at $1,000,000 and the incorporators are: Willis A. Burney, Jr., of Savannah, Ga.; Herschel M. Conner, of Chicago, Ill., and Thomas E. Bayard, of Wilmington, Del.

NICHOLS, GA.—The Nicholas Telephone Company has been incorporated with a capital stock of $2,000 by W. R. Frier and others.

EAST ST. LOUIS, ILL.—The Alton & Southern Railroad Company has been granted a charter to construct and operate an electric railway from the right of way of the Southern Railway in East St. Louis to the St. Louis & Belleville Electric Railway, near Louisiana Boulevard. The company is capitalized at $10,000. The incorporators are: Arthur V. Davis, R. B. Mellon, of Pittsburgh, Pa.; Charles M. Hall, of Niagara Falls, N. Y.; C. B. Fox, Filbert McCulloch, Charles Souder and W. H. Hebenstreit, of East St. Louis, Ill.

HOWE, IND.—The Star Milling & Electrical Company has been incorporated with a capital stock of $10,000 for the purpose of generating electricity for distribution throughout La Grange County. The directors are: Oliver P. McKee and Emanuel Ritzer.

SEYMOUR, IND.—The Four Corners Mutual Telephone Company has been incorporated with a capital stock of $4,000 to construct a telephone system throughout Jackson and adjoining counties. O. M. Downs, of Seymour, Ind., R. F. D. No. 6, is secretary.

FRANKFORT, KY.—Articles of incorporation have been filed for the Cincinnati, Lexington & Licking Valley Railroad Company for the purpose of building an electric railway through Fayette, Pendleton, Kenton and Campbell Counties, connecting Newport and Lexington. The capital stock is placed at $30,000. The incorporators are: Don G. McVean, of Covington, Ky.; R. W. Day, of Scranton, Pa.; F. L. Fuller, of New York, N. Y.; T. J. Foster and W. L. Connell, of Scranton, Pa.; R. H. Reese and Wade H. Lain, of Cynthiana, Ky.

YORK, MAINE.—Articles of incorporation have been filed for the Gila Valley Electric Gas & Water Company. The company is capitalized at $200,000 and proposes to develop and distribute electricity, gas and water rights, etc. The incorporators are: John C. Stewart, president; Louis N. Duval, treasurer, and John C. Stewart, clerk.

SOUTH HAVEN, MICH.—The Citizens' Telephone Company, of South Haven, has been organized with a capital stock of $25,000 and the following officers: George C. Monroe, president; J. J. Clement, vice-president; E. J. Berge, secretary, and A. R. More, treasurer.

KERKHOVEN, MINN.—Articles of incorporation have been filed for the Kerkhoven-Louriston Telephone Company with a capital stock of $5,000 by William and Otto Strom, Fred Armstrong and others, of Murdock, Minn.

HERSHEY, NEB.—The Rosedale Telephone Company has been organized with a capital stock of $5,000 by T. A. Roberts, D. E. Martin and W. J. Shinkle.

LIMA, N. Y.—The Lima-Honeoye Light Company has been incorporated with a capital stock of $10,000 by George W. Olmstead, Ludlow, Pa.; Ellis L. Phillips, 50 Church Street, New York, N. Y., and Edward D. Hamlin, of Avon, N. Y. The company proposes to generate and distribute electricity.

MOUND CITY, S. D.—The Mound City Telephone Company has been incorporated by Gaines Falde, H. G. Fenske, of Mound City, S. D.; G. E. Brophy, N. J. Amundson, of Glenham, S. D. The company is capitalized at $25,000 and proposes to erect both local and long-distance telephone lines in the northern part of the State.

PARKSTON, S. D.—The Starr & Crossplains Telephone Company has been organized with a capital stock of $50,000 by J. H. Weber, Hubert Weber, Lawrence Schilmgen, of Parkston, S. D.; G. Hoffman and Henry Kurtenbach, of Ethan, S. D.

VIVIAN, S. D.—The Vivian-Fort Pierce Telephone Company has been chartered by Warren Young, Frank Whalen and Z. Sutley, of Fort Pierre, S. D.; Arthur Morse and R. Wood, of Vivian, S. D. The company is capitalized at $5,000.

VIENNA, VA.—The Washington-Virginia Railway Company has been granted a charter with a capital stock of $1,000,000 to construct and operate an electric railway from Vienna to Bluemont, Va.

Legal.

LAMP SOCKET LITIGATION.—The U. S. Circuit Court of Appeals for the Ohio circuit has rendered a decision reversing the lower court in a case of alleged infringement of a lamp socket patent granted June 13, 1899, to Charles G. Perkins. In the lower court the Yost Electric Mfg. Co. had been adjudged guilty of infringing four claims of the Perkins patent, but on appeal it was decided that of four Yost sockets in suit, three did not infringe, while the fourth was an infringement. The manufacture of latter socket, however, was, the court stated, discontinued about a year before the bill was filed, when the later numbered styles were adopted.

APPLICATION FOR RECEIVER FOR THE SIERRA NEVADA WATER & POWER COMPANY.—A lis pendens was filed July 1 by the Union Trust Company, of San Francisco, Cal., against the Sierra Nevada Water & Power Company, covering the entire holdings of the company in Amador and Calveras Counties. The company has just been through court proceedings and it was understood that all legal troubles were ended. Arrangements were being made by the power company to commence work on one of the largest water systems in the State to be used for generating electricity and irrigation purposes. The site of the proposed plant is located near Railroad Flat, in Calveras County. Work was begun on the system several years ago, but operations were suspended after the fire of 1906. The property was recently purchased at a sheriff's sale by Frank Z. Towle. The holdings of the company are extensive and include old water rights on branches of the Mokelumne River of over 30,000 in. and four appropriations on the same stream made since 1908 of 64,000 in., including a 55-mile ditch, numerous rights of way, land, pipe lines and other property. Application was made to Judge McSorley to have a receiver appointed. Frank Z. Towle was placed in charge of the property.

Personal.

DR. CHR. DEETJEN, of Baltimore, Md., has sailed for Europe to attend the International Congress for Medical Electricity. He will return the middle of October.

MR. MEYER BARNET has resigned from the Atlanta office of the General Electric Company to accept a position in the power department of the Empire District Electric Company, of Joplin, Mo.

MR. W. R. SWEENEY, who has been contracting agent for the Toronto, Can., civic electrical department, has been appointed by the Board of Control general manager of the electrical department.

MR. H. W. GOTTFRIED, for the past four years connected with the Westinghouse Electric & Manufacturing Company at East Pittsburg, Pa., is now with Messrs. G. & O. Braniff & Company, of Mexico City, Mexico.

MR. E. L. PEARSALL has been appointed general manager of the Susquehanna Light, Heat & Power Company's Gas and electric properties at Bloomington, Ill. Mr. Pearsall was formerly connected with the Altoona (Pa.) Gas Company.

MR. O. B. WILCOX, vice-president of the Central Colorado Power Company, gave an interesting talk at the luncheon last week of the Colorado Electric Club, Denver, on the effect of electrical development on Colorado resources.

MR. BION J. ARNOLD, chairman of the Board of Supervising Engineers, Chicago Traction, has an interesting article on "Rehabilitation of Chicago's Traction Lines," in the July issue of *The Round Table*, of Chicago—a new magazine for the traction men of Chicago and vicinity.

MR. A. B. KRATZ has been appointed superintendent of telegraph and telephones for the Panama Railroad Company, operated by the Isthmian Canal Commission. For some time Mr. Kratz has been acting superintendent of telegraph and telephones for the Panama Railroad Company.

MR. FRANCIS RAYMOND, well known to electrical men in Chicago and vicinity, has accepted a position with the Duntley Manufacturing Company of Chicago. Mr. Raymond has lately given much attention to the introduction of electrically operated pneumatic cleaners, and his work for the Duntley Company will be largely along the same line.

MR. WILLIAM H. BRYAN, of St. Louis, has been certified by the Civil Service Commission of Chicago for the position of chief engineer of the Board of Education of that city. The salary for this position is $8,000 a year. Mr. Bryan is well known to electrical men as a consulting engineer of long standing, and in recent years has made the subject of plant depreciation a specialty.

MR. J. M. BARR, who has been connected with the testing and engineering departments of the Westinghouse Electric & Manufacturing Company, and more recently has been manager of the industrial motor department, has resigned to become manager of the Indianapolis factory of Fairbanks, Morse & Company. Mr. Barr is a graduate of the University of Wisconsin in the class of 1894.

MR. H. H. WESTINGHOUSE has been elected president of Westinghouse, Church, Kerr & Company to succeed Mr. Walter C. Kerr, a notice of whose death appeared in these columns recently. Mr. Westinghouse is president of the American Brake Company, president of the Westinghouse Traction Brake Company, first vice-president of the Canadian Westinghouse Company, second vice-president of the East Pittsburg Improvement Company, vice-president of the Pittsburg Meter Company, vice-president of the Westinghouse Air Brake Company, vice-president of the Westinghouse Machine Company, director of the Westinghouse Brake Company, Ltd. (London), director of the Westinghouse Foundry Company, and director of the Nernst Lamp Company.

Obituary.

MR. W. A. STADELMAN died on July 6 at his home in Rye, N. Y., at the age of 46 years. Mr. Stadelman was at one time a member of the firm of Chadbourne, Hazleton & Company, of Philadelphia, which was quite active in the electric railway and electric motor fields. For several years Mr. Stadelman was identified with the Brown Hoisting Machinery Company, of Cleveland, and the Wellman-Seaver-Morgan Company, of the same city, residing for a time in Cleveland, and later in New York. For the past two or three years Mr. Stadelman was at the head of the Darley Engineering Company, of New York. The funeral services were held in Rye on July 8, and the body was interred in Philadelphia, the former home of the deceased. He leaves a wife and two daughters.

MR. F. H. LINCOLN, vice-president of the Pay-Within Car Company, Philadelphia, was instantly killed Monday morning, July 11, while trying to board a train at the West Philadelphia P. R. R. station. Mr. Lincoln was returning from a visit at Atlantic City to his family, and the fatal accident occurred while endeavoring to catch a Washington train which was pulling out when the Atlantic City train arrived. Mr. Lincoln was born in Boston, May 28, 1867. His first work was in the machine shop of the Walworth Manufacturing Company, and in 1884 he entered the employ of the Thomson-Houston Electric Company, with which he remained until 1891. In the latter year he became connected with the Toledo Consolidated Street Railway, and in 1893 went to Philadelphia to become electrical inspector of the Peoples' Traction Company. This company at the time was changing from horse to electric power, and after a brief service as inspector Mr. Lincoln was given full charge of all the power stations of the company. Upon the consolidation of all of the surface roads in Philadelphia in 1895 he was made superintendent of lines and cables, in which capacity he had entire charge of redesigning and rebuilding the company's electrical distribution system, and was also superintendent of the Willow Grove Line, owned and operated by the Rapid Transit Company. In August, 1895, he was made assistant general manager of the Rapid Transit Company, and in that position had special charge of the Market Street elevated and subway division, as well as the maintenance of equipment of the entire system. Mr. Lincoln patented a number of inventions relating to electric traction, and was one of the co-inventors of the method for converting old-style cars into pay-within cars. Mr. Lincoln resigned in January from the Philadelphia Rapid Transit Company to become vice-president and general manager of the Pay-Within Car Company, which controls the pay-within car patents and is allied with the Electric Service Supplies Company. He always took

an active part in the work of the American Street and Interurban Railway Engineering Association, and last year at the Denver meeting was elected president of that association. He was also a member of the American Institute of Electrical Engineers.

Trade Publications.

FOUNDRY BLOWERS.—Belt type blower equipments for foundry service are illustrated and described in bulletin No. 286, of the American Blower Company, Detroit, Mich.

RHEOSTATS.—The Cutler-Hammer Manufacturing Company, Milwaukee, Wis., has issued a well-executed booklet devoted to battery charging rheostats intended particularly for electric vehicle service. The booklet contains numerous illustrations, full descriptions and complete price lists.

INSULATION ELECTRIC MACHINES.—In a bulletin of the Lincoln Electric Company, Cleveland, Ohio, the process of insulating an induction motor and rendering it waterproof is described and backed up by an illustration showing an induction motor operating under water.

ELECTRIC RAILWAY MATERIAL.—Catalogue No. 8 of the Ohio Brass Company, Mansfield, Ohio, is a well-illustrated 297-page publication dealing with appliances used in the construction, maintenance and operation of electric railways, mine haulage systems and transmission lines.

COUNTERS, REGISTERS AND INDICATORS.—This is the title of a catalog published by the Schaeffer & Budenberg Manufacturing Company, of New York, in which are illustrated and described the various revolution counters, engine registers and tachoscopes manufactured by the company.

FIBRE CONDUIT.—The H. W. Johns-Manville Company, of New York, manufactures a molded indurated fibre conduit for underground work which possesses many advantages. A description of this material was published in our issue of May 19. Other details and prices are contained in a small catalog just issued by the company.

VALVES AND STEAM SPECIALTIES.—The Ohio Brass Company, Mansfield, Ohio, has issued catalog H, devoted to radiator valves, union elbows, globe angle and check valves, pressure regulating valves and steam specialties. Descriptions, dimensions and prices are incorporated in the catalog, whose typographical appearance has much to commend it.

COAL-HANDLING MACHINERY.—The C. W. Hunt Company, West New Brighton, New York, has issued general catalog No. 102, relating to coal-handling and hoisting machinery, conveyors, industrial railways, electric locomotives, electric and steam hoists, "stevedore" manila rope, etc. The catalog contains numerous illustrations and brief descriptions.

ELECTRIC DRIVE IN GRAIN ELEVATORS AND FLOUR MILLS.—Bulletin No. 4742, entitled "Electric Drive in Grain Elevators and Flour Mills," issued by the General Electric Company, describes in considerable detail the application of the induction motor to this work, and contains illustrations of a number of installations in various grain elevators and flour mills throughout the country.

TUNGSTEN LAMPS.—Bulletin No. 4739, issued by the General Electric Company, describes incandescent lamps in which use is made of improved tungsten filaments, which operate at a specific consumption of from 1 watt to 1.25 watts per candle. The bulletin describes this lamp in great detail, and illustrates the various sizes for use on multiple circuits. It contains tables showing cost of operation and life, effect of voltage variation on candle-power and watts, relative costs of lighting with various lamps for equal illumination, etc. It also devotes considerable space to the reflectors necessary to give the best results.

METER TESTING RHEOSTATS.—In bulletin No. 4744, issued by the General Electric Company, is described a device known as a meter-testing rheostat. By means of switches, which form a part of the device, the rheostats may be made to give loads varying from ½ amp. to the full load rating of the rheostat in ½-amp. steps. The rheostat is made in two sizes—one of 15-amp. and the other of 30-amp. maximum rating, weighing 7 and 14 lb. respectively. The device is provided with a handle, and a special arrangement of the enclosing case enables the forming of supports for use while the rheostat is in service.

BUSINESS NOTES.

THE MORGAN CRUCIBLE COMPANY, LTD., of London, England, has opened an American office for the sale of "Morganite" and "Battersea" carbon brushes at 114 Liberty Street, New York City.

THE MINE & SMELTER SUPPLY COMPANY, which maintains large offices and warehouses at Denver, El Paso and Mexico City, with executive offices at 42 Broadway, New York City, announces that it has taken over the agency for the entire western territory of the United States of the well-known lines of pumps made by the Epping-Carpenter Company, Pittsburg, and compressors, made by the Burry Compressor Company, Erie, Pa.

THE WALKER ELECTRIC COMPANY through its western branch in the Monadnock Block, Chicago, recently closed the switchboard equipment for the Chicago & Northwestern Ry. Co.'s Chicago terminal power house. The home office of this company, Philadelphia, reports the closing of the switchboard equipment for the Curtis Publishing Co.'s new power house in that city. These equipments both include very complete outfits of motor-operated remote-control I-T-E circuit breakers. The aggregate cost of these two contracts exceeds one hundred thousand dollars.

INSULATION MAKES HOT FIRE.—A spectacular fire, fed by insulating materials, in the factory of the American Insulated Wire & Cable Company, Twenty-first and Morgan Sts., Chicago, assumed such an alarming aspect at the arrival of the first fire apparatus at 1 a. m., July 6, as to cause second and third alarms for additional companies to be turned in. The fire was in the center of a large wood-working and lumber yard district, but was controlled after causing the complete destruction of the wire company's factory and raw material stores, representing a loss estimated at $60,000. The offices and stock room were not damaged. Following the insurance adjustment, the company will rebuild and re-equip its factory on an enlarged scale.

CROCKER-WHEELER COMPANY ORDERS.—Among the orders recently booked by the Crocker-Wheeler Company, are the following: Two 1000-kw. engine-type generators for the Republic Iron & Steel Company, Hazleton Plant; one 500-kw. generator for A. M. Byers Company, Pittsburgh; one 300-kw. generator for the H. Lauter Company, of Indianapolis; one 175-hp auxiliary pole motor for the Orford Copper Company, of New Jersey; one 1000-kva. alternating current, and one 150-kva. generator for the Big River Lumber Company, of Saskatchewan, Canada; one 150-kva. generator with exciter, for Julesburg, Colo.; one 300-kva. belt type generator with exciter, for the York Card & Paper Co., of Pennsylvania, and two 500-kw. synchronous motor-generator sets for the new Gary plant of the American Sheet and Tin Plate Co.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 5, 1910.

[Conducted by W. F. Bissing, Patent Law, 2 Rector St., N. Y. City.]

963,035. ELECTRIC BOND; T. J. Cope, Philadelphia, Pa. App. filed Oct. 23, 1909. An attaching plate with a tongue and keeper for the plate, the keeper being integral with the plate.

963,062. SECRET TELEGRAPH SYSTEM; W. P. Phillips, Bridgeport, Conn. App. filed Nov. 8, 1909. Provides a telephone receiver for hearing the message, but mutilates the signals on the sounder so as to make them unintelligible to outsiders.

963,064. QUICK-BREAK KNIFE-SWITCH; C. D. Platt, Bridgeport, Conn. App. filed March 1, 1909. Special construction of blade, an auxiliary blade being pivoted to the main blade.

963,090. STEERING APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Sept. 21, 1905. The steering motor is controlled by a plurality of switches and is used to propel fluid to said switches to keep them clean and to blow out the arcs.

963,091. STEERING-GEAR APPARATUS; A. Sundh, Yonkers, N. Y. App. filed Sept. 21, 1905. A steering motor with a starting resistance, accelerating magnetic switches with a rheostat, with a speed governor for controlling the magnets which operate the switches.

963,096. SYSTEM OF ELECTRIC METERING; M. O. Troy, Schenectady, N. Y. App. filed June 3, 1905. For alternating currents and for multi rates, including an actuating coil with series connections and a transformer with a primary connected to the translating devices and a secondary connected to the actuating coil for the meter.

963,118. BURGLAR-ALARM; E. A. Canavan, Duluth, Minn. App. filed Oct. 2, 1908. A hammer and cartridge alarm controlled by a normally open electric circuit.

963,123. ELECTRICAL RESISTANCE ALLOY; J. T. H. Dempster, Schenectady, N. Y. App. filed Feb. 1, 1910. The arm constitutes more than 50 per cent of the alloy which includes iron, nickel, chromium and manganese.

963,127. MOTOR-CONTROL SYSTEM; H. R. Emerson, Schenectady, N. Y. App. filed Nov. 13, 1907. For motor-driven printing presses in which a motor and a resistance and a controller are used with means for regulating the amount of the resistance in the circuit, together with a braking resistance with a switch for throwing it in shunt to the motor armature.

963,132. THREE-PHASE TRANSFORMER; J. J. Frank, Schenectady, N. Y. App. filed April 18, 1908. A device transforming from polyphase to polyphase with its windings star connected and an auxiliary closed secondary winding.

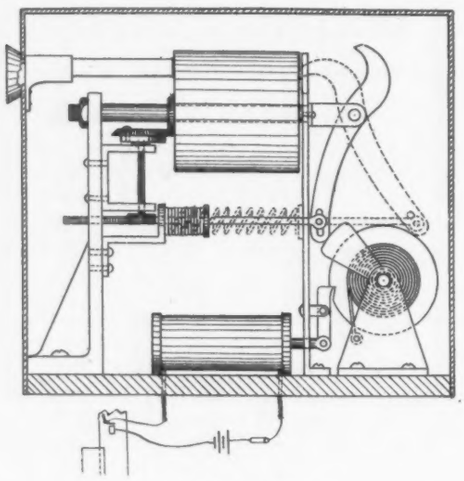
963,138. POWER-TRANSMISSION MECHANISM; M. K. Golden and W. H. Kendall, Detroit, Mich. App. filed Sept. 8, 1909. An

electric motor with longitudinally movable shaft driving a member through a friction clutch with a lever for moving the motor shaft longitudinally.

963,160. STARTING DEVICE FOR ELECTRIC MOTORS; H. H. Lee and A. E. Button, Schenectady, N. Y. App. filed Oct. 27, 1908. For induction motors which are started by means of a primary circuit, a second circuit and a normally open switch for the primary circuit closed by the operator and held closed when the motor is running.

963,163. LIQUID RHEOSTAT: F. Mackintosh, Schenectady, N. Y. App. filed Dec. 18, 1908. A rheostat having a fluid container with electrodes and an auxiliary container connecting therewith with means for raising and lowering one and a no-voltage device for controlling the auxiliary container.

963,169. APPARATUS FOR STARTING ELECTRIC MOTORS; S. B. Paine, Newton, Mass. App. filed May 28, 1909. For starting a plurality of motors by means of switches in series between the



963,118—Burglar Alarm.

motors and the conductors, overload trips for the switches and a compensator to connect the conductors to the voltage of the source.

963,173. OSCILLATION RECEIVER; G. W. Pickard, Amesbury, Mass. App. filed Sept. 14, 1907. An electrical conductor, an electrical contact with a substantially rough, unpolished fracture surface of a conducting solid, namely, the mineral red oxide of zinc.

963,191. LOCK FOR ELECTRIC LAMPS; E. H. Weber, St. Louis, Mo. App. filed Dec. 27, 1909. For preventing the stealing of lamps by means of a lock having separable clamping members and means for preventing vertical movement thereof with a nut and set screw for embracing the lamp.

963,192. COMBINED TELEPHONE AND CONTROL SYSTEM; H. G. Webster, Chicago, Ill. App. filed Jan. 15, 1906. For interconnecting subscribers at central by means of a telephone transmitter and hook in a normally open bridge, a line relay at central and a control relay and a timing device for current impulses to operate said control relay.

963,205. TROLLEY WIRE ICE REMOVER; J. W. Brown, Hubbard, and C. E. Doyle, Youngstown, Ohio. App. filed June 3, 1909. For removing ice by a pneumatically actuated scraper attached to the trolley pole.

963,213. TELEGRAPH APPARATUS; R. L. Dean, Kansas City, Mo. App. filed Feb. 12, 1906. Receiver and recorder consisting of a stylus propelled by a screw with shifting mechanism therefor.

963,216. WOOD SEPARATOR FOR SECONDARY BATTERIES; L. H. Flanders, Edgewood Park, Pa. App. filed Oct. 21, 1908. Separator for electrodes of batteries consisting of wood veneer with wood stiffening ribs.

963,233. LIGHTNING-ARRESTER; B. H. Mann, Webster Groves, Mo. App. filed Aug. 19, 1909. Spark gap terminals connected to each of three conductors overlaid with a glass plate, together with inductance coils mounted thereon.

963,234. CEMENTING-MACHINE; N. Marshall, Newton, Mass. App. filed Jan. 22, 1906. For cementing the filaments of incandescent lamps to the wires by means of a device having a recess for receiving and positioning a stem wire, a device having a substantially aligning recess for the end of the filament, and a filament holder.

963,238. ELECTRIC BUZZER; J. F. McElroy, Albany, N. Y. App. filed Sept. 16, 1909. A magnet with circular diaphragms and supporting clip engaging it at one point with an external portion overhanging the edge of the diaphragm within the range of its vibration.

963,284. STORAGE BATTERY SEPARATOR; E. M. Fitz, Columbus, Ohio. App. filed Feb. 2, 1910. A perforated sheet of insulating material with diagonal ribs on each side.

963,288. TROLLEY WIRE SPLICER; H. L. Griswold and Thomas Kerin, Oakland, Cal. App. filed June 26, 1909. A plate with beveled ends carrying a wire-receiving groove and a clamping lever mounted in each end of the groove for clamping the wire to the beveled ends of the plate.

963,298. TELEGRAPHIC RELAY; I. Kitsee, Philadelphia, Pa. App. filed July 8, 1909. The contacts of the relays consist of graphite in a metallic housing.

963,301. CIRCUIT-CONTROLLER; H. E. Lepert, New Britain, Conn. App. filed May 8, 1909. A door operated push button arranged in a casing. Details.

963,315. COMBINED SWITCH BOX AND SUPPORT; J. J. Odenwald, Washington, D. C. App. filed Feb. 19, 1910. For wiring houses for electric lights, the switch box having a body and cap, the cap being threaded and having a flange with a washer between the flange and the support to which the box is attached.

963,339. ELECTRICAL SYSTEM OF DISTRIBUTION; W. A. Turbayne, Lancaster, N. Y. App. filed Aug. 25, 1906. Train lighting system, having a generator, a battery, a work circuit, a charging circuit, a booster, and independent circuit and a motor for driving the booster.

963,352. SHEET-METAL BOX; A. E. Blackman, Mount Vernon, N. Y. App. filed July 22, 1909. For switch boxes made up of a single piece of sheet metal with the sides folded up.

963,356. RAIL-BOND; C. L. Cadle, Cleveland, Ohio. App. filed March 1, 1906. A laminated flat metal strand with lateral extensions and an arched intermediate portion.

963,374. RELAY; I. Kitsee, Philadelphia, Pa. App. filed Feb. 8, 1909. Cable relay, including a plurality of pairs of magnets with a movable coil for each pair, the coils being secured together on a single moving system, each coil being in its own field and also in the field of another coil.

963,395. RESISTANCE-BOX; L. T. Robinson, Schenectady, N. Y. App. filed Aug. 14, 1909. A base carrying a rigid tubular insulating member with contacts secured to the inner wall to form an unyielding socket for a conducting plug and a resistance strip connected to one of the contacts.

963,412. MAGNETO GENERATOR; C. W. Wilson, Edgewood, Ill. App. filed July 26, 1909. A U-shaped field magnet with resilient limbs and an armature, together with an adjustable member for spreading the pole pieces.

963,425. CONNECTING CLIP; G. Brown Dusinberre; Cleveland, Ohio. App. filed May 29, 1909. For temporary connections consisting of two sheet metal pivoted jaws with an interior spring.

963,432. AUTOMATIC FIRE-ALARM SYSTEM; A. Goldstein, New York, N. Y. App. filed May 23, 1903. A single wire for the thermostat circuit, together with a signal transmitter, transmitting one character of signal for a defect in the circuit and a distinguishing signal for the fire alarm.

963,471. CONDUIT; E. R. Ramsey, Penn Yan, N. Y. App. filed Oct. 29, 1908. Two strips of material wound upon each other with a thread passing through them and locking them together.

963,476. CIRCUIT-BREAKING MECHANISM; W. M. Scott, Philadelphia, Pa. App. filed March 1, 1905. A plurality of electric switches each comprising main and shunt contacts, one above the other, the shunt contacts of an upper switch opening before the lower switch.

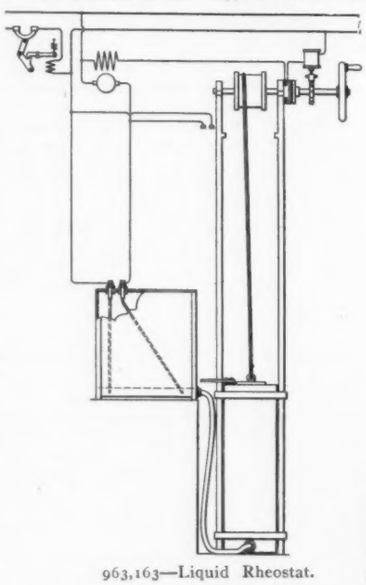
963,480. SWITCHBOARD FOR ELECTRICAL CONDUCTORS; J. F. Skirrow, East Orange, N. J. For telephone system in which the back board carries metal straps and buttons and is perforated so that the conducting pin may pass through it, and is received and held by converging sections of sheet metal.

963,496. LIGHTNING CONDUCTOR POINT AND POINT-ROD PROTECTOR; C. Bajohr, St. Louis, Mo. App. filed Nov. 16, 1909. A platinum tipped point mounted in a tubular jacket of graphite, thus resisting the action of acid gases coming from chimneys, etc.

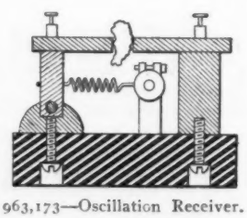
963,508. BRUSH HOLDER; M. Brodeur, Lynn, Mass. App. filed Sept. 16, 1909. The holder has a channel to receive the brush and a follower and guiding means for the follower.

963,571. TROLLEYS; W. W. Hutchinson, Brooklyn, N. Y. App. filed Aug. 1, 1908. To prevent the trolley from leaving the wire, it being mounted on a pivoted bracket, in which it is swiveled, the bracket being secured to the trolley pole.

963,628. TELEPHONE RECEIVER ATTACHMENT; G. S. McComb, San Francisco, Cal. App. filed Dec. 27, 1909. A telephone receiver



963,163—Liquid Rheostat.



963,173—Oscillation Receiver.

with an arm having a segmental bearing and an intermediate portion at right angles to hold the receiver which is attached to the transmitter.

963,678. ARRANGEMENT FOR STARTING AND REGULATING THE SPEED OF ALTERNATING CURRENT MOTORS; E. Arnold, Karlsruhe, Germany, and Jens Lassen La Cour, Edinburg, Scotland. App. filed May 15, 1910. Compensating single-phase commutator motor with the rotor winding in two circuits, one short circuited by the brushes and the other with its magnetic axis displaced ninety degrees and exciting the field.

963,728. ELECTRIC SIGNAL SWITCH; J. I. Ayer, Cambridge, Mass. App. filed Dec. 27, 1909. An electric lamp is provided with an automatic cut-off, which cuts out the lamp when the current fails.

963,733. PLUG SWITCH; J. H. Kliegl, New York, N. Y. App. filed July 22, 1907. The contacts are relieved of strain and the plug has a socket to receive the cable with a binding plate cross one side of the socket, the plate enabling the plug to be withdrawn from its receptacle without transmitting the stress to the connections of the conductors and contacts.